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A  
DISSERTATION  
ON  
M I L K.

BY  
SAMUEL FERRIS, M. D.



A  
DISSERTATION  
ON  
MILK.

IN WHICH AN ATTEMPT IS MADE TO ASCERTAIN ITS NATURAL USE;  
TO INVESTIGATE EXPERIMENTALLY ITS GENERAL NATURE AND  
PROPERTIES; AND TO EXPLAIN ITS EFFECTS IN THE CURE OF  
VARIOUS DISEASES: /

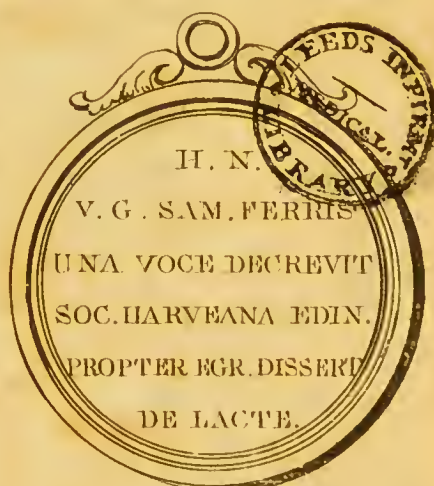
LIKEWISE

TO POINT OUT THE VARIETIES IN THE FOOD OF THE ANIMAL, FROM  
WHICH IT IS TAKEN; AND THE CIRCUMSTANCES IN THE MODE  
OF LIFE AND CONDUCT OF THOSE WOMEN, WHO AFFORD IT, WHICH  
MORE ESPECIALLY TEND TO CHANGE ITS APPEARANCE, AND TO  
IMPAIR ITS SALUTARY QUALITIES: AND PARTICULARLY TO  
ENFORCE THE CAUTIONS AND RESTRICTIONS, WHICH ARE NE-  
CESSARY TO BE OBSERVED BY THOSE, WHOSE DUTY OR BUSINESS  
IT IS TO SUCKLE AN INFANT RACE.

BY  
SAMUEL FERRIS, M. D.  
EXTRAORDINARY MEMBER, AND LATE PRESIDENT  
OF  
THE ROYAL MEDICAL SOCIETY, AT EDINBURGH.

*"Lacte mero veteres usi memorantur et herbis;"*

OVID.



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[1765]





TO  
DR. D. MONRO, DR. R. WRIGHT,  
DR. J. BURGESS,  
AND  
DR. W. H. MUCKLESTON,  
PHYSICIANS:  
AND TO  
J. GUNNING, Esq. J. HUNTER, Esq.  
C. HAWKINS, Esq.  
AND  
W. WALKER, Esq.  
SURGEONS  
OF  
ST. GEORGE'S HOSPITAL,  
LONDON.

GENTLEMEN,

*IT cannot be thought a  
presumptuous boast in our own countrymen,  
since it is a remark made by all foreigners,  
who visit Britain, that there is no one nation,  
upon earth, so alive to the feelings of huma-  
nity,*

nity, so attentive to the cries of the unfortunate and miserable, so ready to relieve the necessities and distresses of their fellow creatures, as Britons. Nor can we place before us an example, which pleads more strongly in proof of this assertion, than the great number of hospitals, which have been erected and are now supported in this metropolis and country, by voluntary contributions, for the protection of those wretched objects, who, by the unrelenting hand of poverty and disease, are deprived of every possible mean of protecting themselves.

Whatever share of so peculiar a blessing is to be attributed to the benevolent example of a great and good King, whatever share to the happier regulations of our state; yet neither the example of the best Father of any people, nor the unbounded benevolence of his most wealthy subjects, nor any system of government whatever, although constructed with consummate wisdom, could be productive of such great ends,



ends, without the assistance of medicines and of medical men.

The characters which you bear, Gentlemen, in your separate professions, are too well known to stand in need of my commendation to render them either conspicuous or respectable. It is by no means my wish, nor intention to insult your understandings, with unmeaning, nor with unmerited panegyrick. A catalogue of thousands, who have been restored to health in St. George's Hospital alone, through your kind and assiduous care, is no small confirmation of your professional abilities nor of your humanity.

As one who have received advantages from attending to the medical practice of that Hospital, and who have the interest and welfare of the institution at heart, I have taken the liberty of inscribing this little work to you ; than whom I know none more deserving the  
good

good wishes of a man, who values nothing  
with greater sincerity than the improvement  
of his profession, either as it serves to extend  
the scope of science, or can contribute to the  
good of mankind.

*I have the honour to be,*

*with all due respect and esteem,*

GENTLEMEN,

*Your very humble servant,*

SAMUEL FERRIS.

*Duke-Street, Manchester-Square,*

*April 11th, 1785.*

## INTRODUCTION.

A N experimental enquiry into the nature and properties of milk, was the prize-subject proposed by the Harveian Society of Edinburgh, in 1782, when I was a student in that University. And, actuated more by a spirit of emulation, than by any presumptive ideas with regard to my own abilities, I became a competitor for the reward offered for the best dissertation on the subject. I had the good fortune to be a successful one : and, as is customary on similar occasions, I had the honour of being publicly presented with a medal, and the elegant quarto edition of Dr. Harvey's Works published by the London College, as a recompence for the attempt which I had made.

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## ii INTRODUCTION.

In respect to my own feelings, I esteemed the honour done me an ample compensation for the trouble which I had taken; nor should I ever have ventured to submit so incomplete a work to publick inspection, but from the persuasion of several of my best friends.

That the subject is worthy of investigation, I think no one, who has bestowed a thought on the very extensive use of milk, both as an article of diet, and as an excellent remedy in the cure of certain diseases, which have a dangerous tendency, will be inclined to dispute.

I am well aware, however materially science may be benefited by the pursuit of experimental enquiry, that a simple detail of a series of experiments, on any subject, is productive of less entertainment and pleasure to the generality of people, than almost any, even the most trivial,  
work,

## INTRODUCTION. iii

work, which is merely calculated to act on the fancy, or to amuse the mind.

Novelty is agreeable to all; and there is a strong propensity in many to prefer that, which is simply entertaining, to that, which may be simply useful. But whatever truth there is in this observation, it by no means vindicates a man in the neglect of the duties which he owes to society; nor can it be urged as a reason, why he should not endeavour to render as much service to the few, who may listen to him, as he is able.

The slightest endeavour to assist our fellow creatures in a point which so materially concerns them as the preservation of their health and existence, is surely laudable. And although any one should fall short of his intention, to contribute to the general welfare and happiness of mankind, by such means, yet the candid  
part

iv INTRODUCTION.

part of the world will become forgetful of his defects, or at least will point them out with delicacy, and will give him all the credit, which the attempt entitles him to.

I confess myself conscious of being in a situation, which requires such indulgence. And as all the merit, which I boast of, is an earnest desire to discharge faithfully the duties of a man, and of my profession, so I trust that I shall be esteemed, by an impartial publick, entitled to that candour, which, if I judge rightly, every man, who arrogates nothing more to himself, has a just claim to.

But as my subject was capable of greater extent, than a mere experimental investigation of its properties could give it, I have endeavoured to render it as interesting, as is in my power, by enlarging likewise



## INTRODUCTION. v

wife on its natural and medical uses.

That, which was designed by the all-wise Author of Nature as the first nutriment of so extensive a race of animals as the class *mammalia* constitutes, cannot possibly be adjudged of small importance in the animal œconomy. And the peculiar properties of milk give it a pre-eminence likewise, in certain circumstances of the body, over perhaps almost every other kind of remedy.

The dietetic part of medicine is often too little attended to by physicians. Many of them, engaged in an extensive field of practice, cannot possibly find leisure to attend to every particular circumstance of the cases of all their patients. They are called upon to prescribe medicines, which, I think, that some too frequently do, when proper regulations with respect to the dietetic regimen

gimen of the patient, would promise happier effects. If I have not been very deficient in my observation, I am sure that I have seen some patients counteracting the design of their physicians, by improper indulgencies in regard to food, because not restricted. And I have seen others gradually sink and die, through mere inanition, when the probable means of restoring them to health were more at hand, than the medicines which were prescribed for them.

Milk is of very extensive use as an article of diet, and its advantages are peculiar, because, with but few exceptions, it is, under some shape or other, alike proper for the valetudinarian and convalescent, as for one of unimpaired health.

I have made it a material part of the business of the following treatise to point out, for whom the use of it  
is

## INTRODUCTION. vii

is proper, and for whom it is not: to ascertain the best mode of administering it under different situations of the body as to health: to notice those remedies, for the taking of which milk proves the best vehicle, and those, the effects of which are rendered more salutary by being combined with it: and I have endeavoured particularly to enforce the cautions and restrictions, which are necessary to be observed by those, whose business or duty it is to suckle an infant race.

As it is no *arcanum* which I extol, I cannot be suspected of an intention to deceive by the applause, which I bestow on my subject. If I have argued more sanguinely in its favour, than many may be inclined to think that it deserves, still all that can be laid to my charge is credulity; for the encomium rests not on my authority alone, but on that likewise  
of

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of some of the first men, whose labours have contributed to the good of mankind, and whose characters have most dignified the annals of our science.

Upon these grounds I expect candour, and candour is all the indulgence I solicit: for “*et refellere sine  
“ pertinacia et refelli sine iracundia  
“ semper parati sumus.*”



A  
DISSERTATION  
O N  
M I L K.

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*On the natural Use of Milk.*

THERE are several circumstances, which seem clearly to demonstrate, that the natural use of milk is to afford the first nutriment to the infant progeny of certain animals: to the whole of that class, which some naturalists distinguish by the appellation *mammalia*.

All the species of this class are characterized by certain glands, or organs of secretion, called *mammæ*, varying in number in different species, the only function of which is to produce or separate this fluid from the blood.

The natural number of these glands in the human species is two, which bear in our own language the name of breasts. Some instances are related of certain per-

B sons

sons having been born with three or four: \* but these are relations of monstrous births.

Notwithstanding the secretion of milk, for the purposes of nature, is confined to the female of every species of the whole class; yet men possess glands of a similar structure, and which are capable, in some degree, of a similar office.

A serous and turbid liquor, like milk, may be drawn from the breasts of almost all new born infants, male and female. † Neither is the capability of affording such a liquor, at all times quickly lost. It has been drawn from the breasts of children of both sexes at different ages, as at three days, three months, five months, two years, nine years old and upward. ‡

An ignorance of this fact, or incredulity has been the source of a barbarous error among some nations: for the people of Scania, a province of South Gothland, whenever

\* Halleri. Elem. Phys. tom. lib. xxviii. p. 4.

† Young De Lacte, p. 2.

‡ Halleri. El. Phys. tom. vii. lib. xxviii. p. 16.

ever it was discovered that a child had been murdered, had a custom of summoning together the neighbouring young women, that it might be tried whether their breasts would afford milk or not; and the result of this trial was esteemed a sufficient proof of their innocence or guilt, nor could the knowledge, nor eloquence of their physicians convince them of the injustice of such a judgment.\*

Whatever grounds for suspicion, in a female, a copious flow of milk may be supposed to give, yet it would be the height of absurdity, nay cruel in the extreme, for any one to conclude a woman guilty, because it might be possible to promote that secretion, when he had been taught from unquestion-

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able

\* “ In Scania puellas de vicinia convocant, si quando infanticidium detegitur, mammaeque emulgent; *a* ex et eo fundamento femina, renitentibus medicis, subpicio adfecta fuit.” *b*

*a* Horlemann. *b* Cardan. *Eph: Nat: Cur: Harder: Haller. El. Phys. tom. vii. lib. xxviii. p. 17 in a note.*

#### 4      DISSERTATION

able authority, so far from being a rare occurrence for virgins to afford milk, that it is by no means so, for men themselves. \*

These facts, however, do not militate against the idea, that the natural use of milk is to afford the first nutriment to an infant race: for whatever capability, infants, virgins or men may have, of yielding that fluid, yet neither its quantity, nor quality as drawn from them, can render it of any possible service in the animal œconomy.

That the woman alone of the human species, and she at no other time, but when it is requisite for the support of her progeny, was designed by Nature to yield milk, which can answer such a purpose, seems as evident, as any truth which has existence. Nor is it less clear that its mother's milk, if she be healthful, is the best of all possible nutriment for every infant.

That Nature has intended it for this wise end, is sufficiently proved, by its peculiar  
increase

\* Haller. El. Phys. tom. vii. lib. xxviii. p. 18.



increase at a time, when it is required for this, and when it can answer no other end; and by its spontaneously disappearing when not made use of: nor is the avidity, with which the infant instinctively seeks the breast, a weak evidence in proof of the fact.

It perhaps would not be difficult to prove likewise, that to pervert the intention of Nature is, in no one instance, of so fatal a tendency, as in a mother's prohibiting her little innocent from the use of that, to which it has so exclusive a claim. And a woman who can and does not suckle her own child, frequently becomes not only the author of well-deserved misery to herself; but, which should not concern her less, of innumerable ills to her own progeny: and these may not indeed stop with the first generation, but, in all human probability, may be handed down from generation to generation hereditarily for ever.

“When a mother does not nurse her own infant,” said a very learned author, who  
was

was an equally skilful physician and good man, "she does an open violence to nature; a violence unknown among all the inferior animals, whom Nature intended to suckle their young; unknown among the most barbarous nations; and equally unknown among the most polished in the purest ages of Greece and Rome." \*

It is a tolerably well ascertained fact, that one half of mankind die under eight years of age, and that this devastation is extremely more prevalent among the children of those, who, either through indolence, depraved taste, or foolish pride, neglect to perform the first duty of mothers.

The children of the poor are, in general, far more healthy and robust, than are those of the rich and luxurious: for happily for the poor, their necessities compel them to become the sole guardians of their own children, and render it impossible for them to give themselves up to unnatural indulgencies.

\* Gregory's Comp. View. p. 33. 34.

cies. In this way are many of the miseries attendant on dependance, and poverty amply compensated.

If neither maternal fondness, nor the dread of entailing disease on posterity can so influence the conduct of a woman, as to restrain her from the neglect of her own infant; it is a circumstance of wonder, that apprehension with regard to her own safety should not induce her, however involuntarily, to perform in some measure a mother's duty.

I believe that there is great reason to fear, that some women are actuated by that ridiculous species of vanity, which renders them more apprehensive of impairing their shape, than they are conscious of the danger of losing their lives. And hence they sacrifice, when it is their misfortune to bear children, all the tender feelings which a mother should possess, and oppose with violence the voice of Nature.

It is undoubtedly the misfortune of many, either from a want of milk, or from some mal-

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mal-conformation of the breasts, to be incapable of nursing: and it is certainly true, that there are many of the latter, who possess milk, as well as of those, who can, but who choose not to nurse, that suffer no inconveniency, or but a trifling one from repelling their milk.

This however is no vindication for her doing it, who can do otherwise. For although a thousand escape, yet no one can on that account promise herself security. Or if she could, still by so unwarrantable a neglect of her own helpless and innocent offspring, she is guilty of one of the worst species of inhumanity.

It was the opinion of the late Dr. Hunter, that a very considerable proportion of those unfortunate women, who are afflicted with cancers of the breasts, are such as refuse to nurse their own children. Even the absurd custom of debarring the infant from the use of the breast for three or four days after birth, or until the breasts swell, or the milk flows spontaneously, is often productive of very serious.



serious, if not of fatal consequences to the mother. Then how much greater must be the danger of total suppression?

It often happens that the thinner part only of the milk, which stagnates in the lactiferous ducts, is re-absorbed, and that the thicker parts remain coagulated; \* and becoming acrid, irritate, and produce painful distention of the breasts and fever, or at other times an abscess or scirrhous swelling, which may ultimately degenerate into cancer. Nay sometimes a sudden repulsion of the milk, when not productive of ills like these, has been the source of others of not less dangerous tendency: for an inflammation of the ute-

C

rus

\* *Diu tamen, et per annos, lactis in mammis aliquid superest et exprimi potest, aut certe incisa mamma, suis in ductibus spissum, flavum et cascosum reperitur.*

*Vidi lacteum in mammis calculum, curvum, ductus lactiferi figuram exprimentem.*

Haller: *Elem. Phys.* tom. vii. lib. xxviii. p. 19. 43.

rus in some, and fluor albus in others, are said to have been its consequences.\*

When such dreadful effects as these arise from unavoidable accident, the woman becomes, from the torment she suffers, an object of the tenderest compassion: but when brought on by her own folly, even humanity herself is deaf to her cries, and withholds the tear of pity.

The first instance, which I ever saw of the bad effects arising from repelling the milk, from breasts ripe for the tender office of nature, was in a friend of my own: and from this instance I was so convinced of the impropriety of doing it, that I have anxiously reprobated, from that time, so unnatural a custom.

She was a young woman of an elegant form, and of a delicate constitution ;

con-

\* Haller: Elem. Phys. tom. vii. lib. xxviii. p. 41.

Gregory's Comp. View. p. 34.

Zimmerman on Experience, vol. ii. p. 263.

Boerhaav: Prax. Med. tom. ii. p. 216.

Lieutaud. Synop. Univ. Prax. Med. tom. i. lib. iii.  
p. 530. 531.

constitution; and on being delivered of her first child, was as happy in every circumstance as a woman could be. About the third day after her delivery, her breasts became full and turgid, and she was extremely anxious of becoming the nurse of her own infant. But, to gratify the absurd request of her husband, who was erroneously fearful of the effects of nursing upon his wife's beauty, she sacrificed all the nice feelings of a fond mother, and gave her child to be suckled by a stranger. All the means, commonly made use of for repelling the milk, were attended to; and every precaution was observed to prevent the occurrence of any bad consequences.

The event however, unhappily for her, proved that the means were inadequate to the end proposed; and that every precaution could not insure her safety.

Her breasts became swelled, extremely painful and inflamed; and the consequent fever was attended with dangerous symptoms. These were indeed at length con-

quered by medical assistance : but her misery ended not here. An abscess supervened the inflammation in one of her breasts, and a long continued drain from this reduced her from a low state, to the lowest ebb of weakness, so that it was with difficulty she was preserved, notwithstanding she could command every care and attention.

Such, on the contrary, are the regulations observed in the different lying-in hospitals, that of 2,400 women in one of them, only two had milk fores,\* and in another only four out of 4,400, and “these had no nipples or former fore breasts.”†

Then as it is so manifest to the observation of every one, that Nature has ordained it to be the peculiar faculty of the woman, to secrete milk of an adequate quality, and in a sufficient quantity, to answer any good purposes in the œconomy of her species ; as the period of its peculiar increase is so exactly

\* Young De Lacte, p. 7.

† Nelson’s Essay on the Governm: of Children, p. 52. in a note.



actly coincident with that period, at which an infant first calls for support; as the dangerous effects, which frequently arise in the constitution of the woman, from repelling the milk, prepared in her breasts for such support, point out the violence done to nature by neglecting to draw it off; as the infant, as yet incapable of reflection, is so constantly guided, by the principle of instinct, to seek the breast for the obtainment of milk, as its first and natural food; and as our experience of the vast excess of mortality among those children, who are most prohibited the use of the breast, teaches us, that their mother's milk is the most wholesome diet for infants; so we cannot hesitate to conclude that the natural use of milk is none other, but to afford to infants the first and most proper kind of food.

Since then the natural use of milk is so evident, and as its properties may be very much varied by the indiscreet indulgencies of the woman, whose breasts afford it; so to ascertain some of the principal circumstances

stances by which its properties can be varied, and to point out the necessary regulations, which it is the duty of every woman to observe, who undertakes the nursing of an infant, cannot be esteemed an object of little importance to society.

There is perhaps nothing more generally known, than that the quantity of milk, which cows yield, is very different in winter and in summer: and that its quality is variously changed, according to the nature of the food which the animal feeds upon.

“ A cow which feeds upon rank and watery grass, yields milk that contains very little *crassamentum*, and is therefore unfit for the purpose of making cheese.” \*

That kind of grass which we distinguish by the name of old pasturage, affords the best kind of cows milk; and as it is most in perfection in the months of May and June, so is the quantity of milk likewise, which cows yield in those months, greater in proportion: while during the winter, when  
the

\* Percival's Essays, 2d edit. vol. i. p. 254.

the only food, which can be allowed them, is hay and straw, the milk, which they then yield, is poorer, bitterish in taste, less in quantity, nor of so rich a yellow colour. But on the addition of fresh vegetables to that food, it is presently improved in every respect.\*

The taste and colour of such milk is likewise rendered very various, in consequence of the animal feeding on certain plants. Thus its flavour is far more grateful, after the cow has fed on the old pasturage, than on meadow-trefoil. *a)* It is rendered very unpleasant from her eating of the broad leaved wild garlick, *b)* or of horse-mint, *c)* or of treacle-mustard, *d)* or of lovage. *e)* A certain species of sow-thistle *f)* is said to render the milk of the rein-deer disagreeable.†

Steno

\* Young De Lacte, p. 11.

Hoffman. Oper. omn. tom. i. p. 80. tom. iii. p. 290.

*a)* *Trifolium pratense.* *b)* *Allium latifolium palustre.*

*c)* *Mentha sylvestris.* *d)* *Thlaspi.* *e)* *Ligusticum.*

*f)* *Sonchus pedunculis squamosis, floribus racemosis.*

† Young De Lacte, p. 11. 12.

Neumann's Chem. Works, by Dr. Lewis, p. 569.

Steno C. Bielke observed, that the taste of milk is affected by the umbelliferous plants, and by most of the *tetradynamia* of Linnæus.\* It has been remarked by another author, that the milk of cows which have eaten of spurge *a)* is apt to induce a dangerous vomiting and diarrhæa, in those who use it. And by another that the hedge hyssop *b)* eaten by cows imparts its purgative quality to their milk†. And that, from this circumstance, the milk of those cows, which feed in the fields of Ebrodunum, a town of the diocese of Ambrun in France, where this plant grows plentifully, is held in great dis-repute.‡ And that the colour of cows milk may be also changed, has been demonstrated by the late Dr. Young, who produced a redness in the milk of several cows, by feeding them with madder.*c)* §

The

\* Young De Lacte, p. 12.

*a)* *Tithymalus.* *b)* *Gratiola.*

† Lewis's Mat. Med. by Aikin. p. 371.

‡ Halleri. El. Phys. tom. vii. lib. xxviii. p. 26.

*c)* *Rubia Tinctorum.*

§ De Lacte, p. 56.



The richer consistence and inferior laxative quality of goats milk compared with that, which the ass affords, has been attributed by some to the goat feeding on the leaves and green boughs of trees, and on balsamic herbs, which contain a quantity of resin.\* And hence it has been esteemed useful in the cure of the coeliac passion.†

Mr. Boyle observed, that many could tell whether their asses had been well curried or not, by the taste of their milk.‡

An acquaintance, with such circumstances as these, induced some of the ancients to conclude, that milk might be rendered an excellent remedy against certain diseases, by feeding cows for the purpose on those herbs, which were esteemed specific in the cure of such diseases.

Hence Galen asserted that the milk at Stabiae, a town of Campania, was particularly salutary, on account of the growth of

D certain

\* Hoffman Oper: om: tom. iii. p. 289.

Lieutaud Synop. Univ: Prax: Med. tom. 2. p. 17:

† Haller: El: Phys: tom. vii. lib. xxviii. p. 26.

‡ Phil: Trans: No. 12. p. 206.

certain peculiar vegetables in its neighbourhood.\*

Roefner mentions the advantageous use of the milk of those cows, which eat of the pellitory of the wall, *a*) in the cure of dropfy: of those which consume madder in the rickets: of those which take largely of the lesser nettle *b*) in the cure of the piles: and of those which eat of the lettuce *c*) and purflain *c* in costiveness. *d*)

Hoffman likewise informs us, that he has ordered with success different kinds of plants to be mixed with the common food of cows, according to the medical intention, which he had to answer by the use of their milk. §

It is not less certain, that the properties of human milk are in a similar manner  
very

\* Meth: Med: lib. v: cap. 12.

Hoffm: Oper: om: tom. iii. p. 290.

Haller: El: Phys: tom. 7. lib. xxviii. p. 42.

*a*) *Parietaria*. *b*) *Urtica minor*. *c*) *Lactuca*. *d*) *Portulaca*.

‡ Haller: El: Phys: tom. vii. lib. xxviii. p. 26. 27.

§ Hoff: oper: omn: tom. ii. p. 180. tom. iii. p. 290.

very much regulated by the properties of the *ingesta*, mode of life, and passions of the woman from whom it is taken :\* nor that the infant nourished by it must be the innocent participater, of all the ills arising from the misconduct of its nurse.

After the internal use of the milkwort a) or wormwood, a woman's milk becomes bitter: and fœtid from her taking of the treacle-mustard: and the odour of thyme and of saffron is communicated to her milk, when she has eaten of those articles.

Saffron likewise imparts a yellow colour to her milk, *opuntia* and madder a red colour,

D 2

lour,

\* Pro vi, et differentia assumptorum lac diversum esse; ex illis enim chylus melior vel deterior, dulcis vel amarus, ex hoc tale lac; qualia enim ingesta talis chylus, qualis chylus tale lac, assertum quotidiana confirmat experientia."

Crantz: Mat: Med: p. 80.

Hoff: Oper: om: tom: I. p. 81. 132. 133. tom. iii. p. 471. tom. iv. p. 152.

Nelson's Essay on the Governm: of Child: 3d edit. p. 49. 80.

a) *Polygala* or *Amarella*.

lour, and a blueish cast is derived from the use of indigo.\*

It is likewise a fact well authenticated, that purgative medicines taken by the women often produce their specific effects on the infant, which partakes of her milk:† and it has not been a circumstance of unfrequent observation, when the medicines have been of the drastic kind, that such effects have been violent and dangerous.

A woman by drinking strong spirits has been known to induce convulsions in her sucking child.‡

That

\* Haller: *Phyf: El:* tom. vii. lib. xxiv. p. 26.

Hoff: *Oper: om:* tom. i. p. 80.

† Haller: *El: Phyf:* tom. vii. lib. xxviii. p. 26.

Hoff: *Oper: om:* tom. i. p. 80. 132. tom. iii. p. 290. 475.

Neumann's *Chem: Works* by Dr. Lewis, p. 569.

Boerhaav: *Prelect*, § 690.

Dr. Hamilton, the Professor of Midwifery, in the University of Edinburgh, informed me, that he once detected the globules of mercury, by slow evaporation, in the milk of a woman, who had taken that medicine in considerable quantities.

‡ Haller: *El: Phyf:* tom. vii. lib. xxviii. p. 26.

Hoff: *Oper: om:* tom. i. p. 132.

Nelson's *Essay on the Gov: of Child:* p. 76.



That infants will become intoxicated, in consequence of their nurse having drunk wine or spirituous liquors, is, I believe, certain beyond dispute. \* And an instance has been known “ where a nurse by eating of cabbage, or of other flatulent vegetables, always gave the child the windy gripes.” †

Sudden passion, in a nurse, is often a source of such a change in her milk, as to disorder the infant which she suckle extremely; sometimes green stools and griping pains, at other times constipation, flatulency, convulsions, nay even epilepsy and death, are said to have been the fatal result of such a cause. ‡

Nor are these accidental circumstances in nursing-women, the only sources of disorder in their little and innocent charges; for they often derive from the breast the  
seeds

\* Boerhaav: *Prælect.* § 690.

Cadogan's *Essay on Nursing*, &c. 10th edit. p. 38.

† Percival's *Essay*, 2d edit. vol. I. p. 257.

‡ Hoff: *Oper. om. tom. i.* p. 81. 132. 134. 189.  
*tom. ii.* p. 282. *tom. iii.* p. 12. 471. 474. 484.

feeds of the worst disorders,\* and carry with them through life the direful effects, of the depraved and vicious habits of those who nursed them.

Many have held an opinion, that not only the diseases of the body, but that the disposition of the mind also is derived, in a great measure, through the medium of the milk, from the mother or nurse.

Thus Hoffman asserted that he knew infants particularly inclined to drinking, that had been fostered by a drunken nurse.†

A lady, whose authority cannot but be esteemed indisputably good, assured me of an instance in an infant, which very much corroborates this opinion. Its mother, from some unfortunate circumstances pertaining to herself, was incapable of nursing; and gave her infant to be nursed by a neighbouring poor woman;

\* Gregory's Comp. View, p. 22. 40.

Hoff: Op: om: tom. iii. p. 474.

Lieutaud Synops: Univ: Prax: Med: tom. i. lib. iii.

p. 530.

† Hoff: loco supra citato.

woman; unknowingly, to one not a little addicted to drinking brandy. After a considerable time had elapsed, her infant not thriving so well, as her hopes led her to expect it would have done, she took it home: and, with the partial fondness of a mother, endeavoured to nourish it by other means than the breast. But here her child became daily worse. In the interval however, she had been informed of the habits of the woman, to whom she had at first intrusted her infant; and rationally concluded, that, however much the milk of such a woman might have disagreed with it, yet the sudden change from that milk to the kind of food, with which she was then feeding it, was at least equally detrimental. And from this idea she added a little brandy to whatever she offered it. From this time the child grew daily better, and at length acquired the natural health and strength of its years: when it became its mother's care to wean it of the brandy, as she would have done of the breast.

Wirdig

Wirdig was so strenuous an advocate for such an opinion, that he contended, that those infants, which are nourished at the breast of a stranger, for the most part, degenerate: that they are naturalized to the nature of their nurse: that they derive their constitution from the nourishment, which they take from her breast; and through that medium, their disposition from her temper of mind: that the most ferocious animals are rendered gentle by human milk, on account of the principles of gentleness, which they imbibe with it: and that men, on the contrary, as did Romulus and Remus, acquire the fierceness and ferocity of brutes, by feeding on the milk of brutes.\*

What-

\* Alieno lacte nutriti ut plurimum degenerant, & ad nutricum naturam naturalisuntur; ex lacte & spiritibus nutricum, adsumunt naturas nutricum & mores: lacte humano cicurantur ferocissima animalia, ob spiritus temperatos, quos una cum lacte sugunt; ut contra homines ferino lacte educati ferini fiunt & feroces, ut Romuli testatur exemplum & Remi.

Wirdigii Nov: Med: Spirit: lib. i. cap. 25. § 6.



Whatever objections may be urged against these opinions taken in their full extent, still it must be allowed, that they are not entirely without foundation.

That certain effects produced on the constitution of infants derive their origin from this source, and this only, is an unquestionable truth.\* And perhaps it is warrantable to conjecture, from the facts related, that certain peculiarities of the mind are effects of the same cause.

It is at least a reflection well worthy the serious concern of every parent, that it is possible for a hireling, who suckles an infant, to acquire by degrees the solicitude and tenderness of a mother, and to alienate from her a mother's rights, by securing to herself a preference, a kind of parental affection from the child.†

No one can dispute the possibility of such disadvantages as these, even supposing them

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the

\* Hoff: Oper: Om: tom. iii: p. 474.

† Gregory's Com: View. p. 39.

the effects of habit merely, nor that a long train of bodily ills are in fact very often communicated, by the nurse to the infant. Then what woman of sensibility would give up her child to the risk of being contaminated; and hazard an alienation of all her tenderest rights as a mother.

It is a deed so unnatural in itself, that nothing, but the most insuperable impediment, can vindicate it.

There is likewise an error, often attended with bad consequences, which many, even of those mothers, run into, who are most awakened to the voice of Nature; who possess all the exquisite feelings of maternal fondness; and who are most anxious of enjoying the pleasures, which result from rearing a progeny, to which they have given existence. The error, which I allude to, is the interrupting the instinctive efforts of an infant to take an earlier possession of the breast, than is commonly permitted it to do. The inconveniencies, which the mother renders herself liable to, from conforming  
to

to this ill-judged custom, I have hinted at before. But there are others of as serious a nature, which may befall the infant. It is known to all that the bowels of a new-born infant require early evacuation, lest the glaucous liquor or *meconium*, by being detained too long, should occasion disorder in the system. But why should we suppose that there is a necessity for the interposition of art, in every instance? Why for ever force purgative medicines down the throat of an infant, whose stomach nor bowels are in a state to bear an irritation, like that, by which such medicines produce their effects.

Great caution is undoubtedly necessary in prescribing under such circumstances, for infants are very often affected with epilepsy during the first month, from too frequent purging.\*

We cannot but suppose that in the early ages of society, before the properties of any one simple of the *materia medica* had been

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investigated

\* Sydenham de Epilep: Pueror: in Proces: Integ:

investigated, that infants, relying solely for medicine and support on the food of Nature, were as healthful as the progeny of this age. We cannot but suppose, that there are nations even now, to whom the refinements of physic are utterly unknown, whose infants notwithstanding do perhaps better without this kind of fancied assistance, than ours do with it.

To any one who has paid the least attention to the subject, it is well known that the *colostrum* or first milk of the mother is of a laxative quality, and that it always answers the wished-for end, without danger to the infant.\* Then why fly in the face of Nature? Why be apprehensive of danger when under the sole guidance of Him, Who is in all other respects so mindful of our safety and well doing?

It has been remarked that “calves, which are the only animals taken under our peculiar

\* White's Treat: on Preg: and Lying-in Wom: 2d edit: p. 57. 3d. edit: p. 146.

Nelson's Essay on the Gov: of Child: p. 52. 75.

Cadogan's Essay on Nurfing, p. 21.



liar care in these circumstances, are treated in the same manner. That they have the same sort of physick administered to them, and often with the same success, many dying under the operation, or of its consequences.”\*

It is a particularly barbarous custom with respect to infants, and it has been indeed with much propriety neglected in our hospitals, and should be condemned in every instance.

To lay down particular rules, by which every nurse may preserve her milk as pure and as fitted for the infant as possible, is extremely difficult, although the general one is evident. Temperance in diet and quiet with respect to the mind is most obviously the general one. But temperance is a relative term, which every woman is better qualified to define as far as it pertains to herself, than her physician is for doing it for her. She knows or ought to know best what kind of food, and what mode of life is the most congenial

\* Gregory's Comp. View. p. 30.

congenial to her own health; and she should endeavour to deviate as little as possible from the standard of either :\* particularly avoiding excess in the use of heating and of acrid food, and of acid and of spirituous liquors.†

As to the food of her infant there cannot be a doubt but that her own milk, if the secretion be in the least copious, is sufficient to answer every nutritive and salutary purpose, for the first nine, ten, or twelve months. But soon after that time, according to the circumstances of the mother, the child ought to be gradually taken from the breast, and to be accustomed to another kind of diet. At first to one as nearly as possible allied to that, of which it is newly deprived, and so on from a stronger to the strongest, by slow degrees.‡

I wish it to be understood, that I am treating on the conduct of healthful women only, for there are many mothers, whose  
own

\* Nelson's Essay on the Gov: of Child: p. 58. 59.

Gregory's Com: View. p. 43.

† Hoff. Oper. Omn. tom. iii. p. 471.

‡ Nelson's Essay, p. 57. 73. 115.

Cadogan's Essay on Nursing, p. 24. 25. 37.

own maladies render their milk improper for their children: many who have not a sufficient quantity for their support: and many, who, from accidental circumstances or from a weak constitution, are compelled to wean their children at an earlier period.

It is the custom in many parts of Europe and in all the Levant, to suffer children to taste no other food but their mother's milk until they are a year old: and children thus fed may be permitted to take the breast as often, as the sensation of hunger instinctively prompts them. Should they take more than is sufficient to answer the demands of Nature, they reject whatever is superfluous without inconveniency, as they do it without sickness or straining.\*

But to obtrude pap on the stomach of a new-born infant, or water-gruel, or any other unfermented and indigestible food is doing a violence to nature: and is the source of flatulency, incessant cholic, diarrhæa,

\* Gregory's Comp. View. 40. 41. 42.

rhæa, and a thousand other ills if not ultimately of death.\*

Almost every sign of uneasiness is esteemed an indication of hunger in an infant, and hence more food is forced into the stomach of one, than ten would bear with conveniency.

At so early a period of existence nature requires very little food, although a good deal of rest. But a more ready way of divesting them of this altogether could not be devised, than by their nurses giving way to the dangerous error of over-feeding them.

It is a duty incumbent upon every man, to speak without reserve, on a point which concerns the general welfare of his fellow-creatures. It is being falsely delicate and dangerously polite to hide the truth, (when to hide the truth is injurious to society) merely because divulging it may reflect a censure on those, whom every well bred and polished man

\* Zimmerman on Experience, vol. ii. p. 184.

Gregory's Comp: View. p. 41.

Hoff: Oper: Om: tom. i. p. 107. 133.

Nelson's Essay on the Govern: of Chil: p. 67. 72.

Cadogan's Essay on Nursing, p. 4. 8.



man would study more to oblige, than wish to offend. And however unpleasant the task, it is more friendly to correct than to flatter the dangerous follies of human nature.

Although a sense of my duty, as a member of society, actuates me to contribute as amply as I am able towards the extirpation of error, yet "I am conscious," as the late Dr. Gregory observed, "that it is an unpopular attempt to attack prejudices established by time and habit, and secured by the corruptions of luxurious life. That it is equally unpleasant to attempt the reformation of abuses without the least prospect of success." But every good man must enjoy, as he did "a secret pleasure in pleading the cause of humanity and helpless innocence." \*

Perhaps some may be disposed to think that the natural use of milk is not limited, as I have been inclined to suppose it, to the necessities of infant animals alone. But that certain of the class *mammalia* were formed, by the Author of Nature, with the peculiar view of being subservient to the wants of

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men.

\* Comp: View: p. 25, 26.

men. And that he invested them with the faculty of yielding a greater quantity of milk, than is necessary for the support of their own young, for the purposes of the adults of our species.

What in fact is the natural food of mankind is a question involved in much obscurity; and to discuss it here would be unnecessary, and would give too extensive a scope for digression from my proposed subject.

That the gradual introduction of refinement, and luxurious pleasures, a fondness for cruel sports, and the depraved appetites of mankind have led men to encroach on the benevolent bounty of Nature, is what, perhaps, but few will hesitate to believe. And I acknowledge myself disposed to think, that the milk of the cow, and of other domestic animals, is rather an article which the pleasures or necessities of mankind first taught them to add, to the natural catalogue of diet.

The dietetic system of most polished nations is almost as much the offspring of popular prejudice or of fancy, as the habiliments

ments which they wear. But that of the rude and uncultivated must be more the result of chance or of necessity.

Rice constitutes the principal food of the Turks; and of the inhabitants of the coast of Malabar, where they have no wheat. The Chinese eat it prepared as we do bread.\*

Vegetables and butter are said to be the chief food, among those who inhabit Bengal. And leguminous plants of the traders who pass from the Coromandel coast, and Surat to Batavia.†

The Laplanders and other northern nations, especially those, who live most towards the Pole, feed much on animal diet, for they have few vegetables; but to prevent the ill effects which might result from the use of so alkalescent a food, it is the custom among many of them to take plentifully of sour milk.‡

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The

\* Zimmerman on Exp: vol. 2. p. 174.

† Ibid: p. 176.

‡ Ibid. in a note. and p. 189.

Cullen's Mat: Med: Dublin edit: p. 95.

The Icelanders drink the oil of fish in considerable quantities.\*

In Holland and in other southern countries and in Frisia many drink milk, as a substitute for beer.† Milk is also the most common food of the Egyptians, while the Japanese scarcely use any.‡

It is pretty generally believed that the salutary properties of milk, are impaired by boiling, but “ a physician who should deliver such a doctrine in Switzerland, would perhaps be in danger of his life from the rage of some good woman.”§ And thus through every region of the globe, whoever is right, whoever wrong, *sua cuique satis placent*.

Milk, whether boiled or not, is beyond doubt a very excellent species of food for many people. Galen asserted, that a man lived upwards of 100 years on milk alone.

\* Zimmerm: on Exp: vol. 2. p. 194.

† Hoff: Oper: om: tom. i. p. 107.

‡ Haller: El: Phys: tom. 7. lib. xxviii. p. 42.

Zimmerm: on Exp: vol. 2. p. 189.

§ Ibid: p. 183.



alone.\* But arguments may be adduced which seem to point out, that Nature designed it for the use of those animals only, which have organs for secreting it.

All the species of the class *mammalia* that run wild and are in a state of nature, have milk only when their young require it.

In order to secure a copious flow of milk from the udders of domestic animals, we rob them of their young very early, and thus obtain that, which would otherwise have served for their sustenance and nourishment. Abstain from so unnatural a theft

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*— nec tibi fœtæ,  
Mœre patrum, nivea implebunt mulctralia vaccæ;  
Sed tota in dulces consument ubera natos.*

VIRG.

If such animals have no young, we promote the secretion of their milk, by the repeated stimulus of friction to their dugs, upon the same principle as milk may be drawn from a virgin or a man.

It is painful and dangerous to domestic animals, as it would be to a woman, to stop suddenly from drawing milk from them,

at

\* Lib. v. De Sanit. tuend. cap. 7.

at a time, when their udders are periodically full and turgid from habit. But they would become dry without inconveniency, were we to take less and less every day, until we ceased altogether.

Thus a woman suffers but little from the gradual weaning of her infant, and she loses her milk, by degrees, as the stimulus of suction is abtained from. But by continuing the stimulus, the effect is continued\* as long as she pleases; just as domestic animals yield milk, in proportion to the frequency of milking them. In this way some women have been known to suckle their children for years: but that this is unnatural, no one I imagine will dispute. And as it is possible to protract the secretion of milk in the breast of a woman, far beyond the acknowledged limits of nature, so to continue the secretion in domestic animals by similar means, to a comparatively similar period of time, cannot, as it appears to me, be otherwise than unnatural.

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\* Borchaav. Institut. § 688.

ON THE  
NATURE AND PROPERTIES  
OF  
M I L K.

**I**N the next place I shall proceed to relate the experiments, which I made, with a view to ascertain the nature and properties of milk, agreeably to the design of the proposed question.

I boast of nothing but of being faithful in my account of facts. If my mode of reasoning on causes from observed effects be esteemed improper, and my consequent deductions erroneous, I am open to conviction; and when convinced, am more willing to yield, than to be wrongly stubborn in opinion. But if the results of the experiments which I have made, tend, in the least, either to confirm that, which has been already advanced; or should they, confuting any received but ill-grounded doctrine, point out the path to truth, they will not be denied their share of merit.

Milk

Milk is a white, opaque, bland fluid secreted by certain glands, which are peculiar to viviparous animals, and which, as it has been already observed, characterize that class, to which some naturalists have given the appellation *mammalia*. When first drawn from those glands, it appears homogeneous; but its own spontaneous separation into three distinct parts, on standing at rest for some time, determines it to be an heterogenous compound. And thus considered as a fluid compounded of heterogenous substances, I have endeavoured to investigate its nature and properties.\*

The first experiments that I attempted, were with a view to determine, whether there be any essential difference in the general

\* New milk has a glutinous quality, so as to be used for joining broken stone-ware. In the Breslau collections for the year 1720, there is a remarkable account of milk (which probably was that of the ass) grown so thick and tenacious as to be drawn out into long strings, which when dried were quite brittle—but cheese properly prepared has a far greater tenacity.

Neumann's Chem. Works, by Dr. Lewis, p. 573.



neral properties of the milk of ruminating animals, and of those animals which do not ruminate. And in order to observe first of all their

SPONTANEOUS CHANGES,

I took an equal quantity of human, mare's, asses, cow's, goat's and ewe's milk, and placed each separately at rest, in a temperature of about  $65^{\circ}$  of Farenheit's thermometer; when sooner or later cream appeared, in different proportions, swimming on the surface of each.

I left them still at rest, and each acquired some degree of acidity: the consequence of which was a uniform coagulation in the goat's, ewe's and cow's milk. But although left still longer in the same situation, even until evidently acid, yet no such coagulation took place in either the human, the mare's, or in the asses milk, until removed into a temperature of about  $100^{\circ}$  of Farenheit's scale. Here some decomposition and precipitation took place in each: more copiously in the asses than in the mare's, and

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in greater quantity in the mare's than in the human milk.

### SUGAR OF MILK.<sup>1</sup>

Having clarified the whey of these six kinds of milk with the whites of eggs; I obtained from an equal quantity of each, by evaporation, a sweet saccharine substance varying as to proportion in the following order:

The greatest from

- |           |            |
|-----------|------------|
| 1. Affes  | 4. Cow's   |
| 2. Human  | 5. Goat's  |
| 3. Mare's | 6. Ewe's.* |

### RESIDUUM

\* This arrangement varies a little from that, which Dr. Young gave as the result of the experiments which he made. According to him the mare's milk afforded rather more of the saccharine part than human milk. But the Doctor obtained this saccharine part, by a method somewhat different from that, which I followed. for he obtained it, "*Lac evaporando ad pulverem ficcum, dein hunc pulverem in aqua frigida solvendo et filtrando, denique liquorem filtratum itidem evaporando ad ficcitatem.*"

Young *De Lacte*, p. 31.

Gaubius prepared a similar sugar by repeatedly boiling and filtering the whey, until it acquired the consistency of a syrup, and when placed in a cool situation the saccharine part crystallized into a cake like mass.

Edin: Med. Essays, vol: 1. p. 335. 336.

## RESIDUUM.

I took other equal quantities of these different kinds of milk, and by a gentle heat I dissipated their aqueous part. A tough brown residuum was left of each, sweet to the taste, and partly again soluble by being boiled in water. The proportions of these residua were in the following order :

The greatest from

- |           |            |
|-----------|------------|
| 1. Ewe's, | 4. Asses   |
| 2. Goat's | 5. Mare's  |
| 3. Cow's  | 6. Human.* |

I distilled a small quantity of each of these residua separately in a glass flask-retort, gradually increasing the heat to the melting of the retort; and the results differed only in the proportions of the products.

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EXPE-

\* Hoffman found the quantity of residuum from cow's milk to be rather more considerable than from goat's; and that from asses and human milk equal. But Dr. Young observed, as it occurred to me, that the quantity of residuum was greater from goat's than from cow's milk. He took no notice of the relative proportion of that from asses and from human milk.

Young De Lacte, p. 33. 34.

## EXPERIMENTS WITH ACIDS.

I next took other equal quantities of these same six kinds of milk, and to each I added a similar proportion of muriatic acid. The ewe's, cow's, and goat's milk soon became more or less coagulated; there was no change on the asses milk immediately, but presently there was some degree of decomposition and precipitation.

On adding this acid to mare's milk, some decomposition almost immediately ensued, but presently a re-solution; the mixture becoming more pellucid than before.

These experiments were repeated with nitrous acid, with similar effects; except that the mare's milk upon the re-solution, was not so transparent as in the former instance.

Again, I repeated the same experiments with vitriolic acid; and the effects were similar; except that in the mare's milk, after the decomposition and re-solution, some small degree of decomposition took place again, with precipitation.

Neither



Neither of these acids effected any change in human milk, except that of rendering it a little more pellucid, although its heat were gradually increased to the boiling point.

#### EXPERIMENTS WITH ALKALI AND RENNET.

I likewise added to equal quantities of each of these six kinds of milk, similar proportions of vegetable fixed alkali, and of rennet separately. The ewe's, goat's, and cow's milk were very soon more or less coagulated by each. No evident change was made by either, upon the asses milk, until the application of heat, when a decomposition took place.

The mare's milk was but little altered at first by either, but afterwards some decomposition was produced by each. The woman's milk was altered by neither.

#### CONCLUSIONS.

Perhaps, every one, were he to consider the subject *a priori*, would be led to conclude, that he might justly infer, from the similarity in appearance of the milk of all animals

animals, that there exists likewise a similarity in the general properties of each. And I am inclined to conclude, judging *a posteriori* from the results of the experiments which have been related, that such an analogy may be allowed without hesitation. That is, that the milk of all the animals, the milk of which has been the subject of these enquiries, is in reality a similar composition, which differs only in the proportions of its three general component parts.

There are, without doubt, some circumstances in which the milk of each of these animals differs from that of each other. And by the experiments of Dr. Young, which I had it not in my power to repeat,\* it has been proved, that there are circumstances in which the milk of animals of the same species

\* Dr. Young had many cows, mares, asses, goats, and ewes at his command: and being Professor of Midwifery and in an extensive practice in that line, he could more readily procure the milk of many different women, than I could possibly do, in order to ascertain particularly the relative proportions of the component parts of the milk of all; as well as the average proportions of those parts in each.

species varies; of the same animal at different times; nay, of the same animal at different periods of one milking. But Dr. Young's Experiments likewise prove, that these are differences, which only respect the relative proportions of the three evident component parts of milk, cheese, whey, and cream or butter.\*

Such varieties as these, however inexplicable, must be inevitable from the nature of things.† But as they pertain alone to the relative proportions, and are not essential differences with respect to the general properties, or the specifick nature of the different component parts of milk, so I do not see that they can affect that analogy, which I think the experiments that I have related tend to establish, between the milk of ruminating animals and of those animals, which do not ruminate.

I have already remarked that the residua

\* Young De Lacte, p. 10: 11. 12.

† A difference of constitution, a variety of pasture, vicissitudes of seasons, different periods of bringing forth young, &c. are all probable causes of such varieties.

dua from the cow's, goat's, and ewe's milk were in far greater proportions, from equal quantities of milk, than were those from human and from asses milk. I would further remark, that the residuum from human milk, was rather less in quantity than from the mare's: but that that from the mare's was less in proportion than the residuum from asses milk.*a)*

From these facts, together with the dissolving power of mineral acids upon the cheesy or mucilaginous part of milk, I was inclined to account for the phenomena, which appeared on the addition of those acids to human milk and to that of the mare. *b)* For in the human milk, in which there was the least proportion of coagulum, there was no other evident change on adding the mineral acids, but that of its being rendered a little more thin

I own I was at first somewhat surprised at this effect, as I had observed effects so different upon adding the same acids to cow's milk,

*a)* page 43    *b)* page 44. 45.



milk, &c. But afterwards, when I found that the mineral acids possessed the power of dissolving the coagulum of milk, I thought it a just inference, that the quantity of coagulum in human milk was too small to be precipitated by those acids, especially as the coagulum is never entirely separated from the serum of any milk whatever, not even by rennet, which possesses the greatest coagulating power: or that those acids acted immediately as solvents upon the coagulum so small in quantity; and, in consequence, produced that greater thinness which I have before taken notice of.

I have said, that in the mare's milk, there was rather a greater proportion of coagulum; and hence, I imagine, arose the decomposition prior to a compleat solution of the coagulum in those acids: for this likewise was presently more pellucid than before.<sup>a)</sup>

H

In

<sup>a)</sup> page 44. 45.

In the asses milk, where there was yet more coagulum, some decomposition was permanent, *a)* which I consider to have been that portion of coagulum, which the quantity of acid that I added was not sufficient to dissolve.

EXPERIMENT WITH VITRIOLIC ACID  
AND  
COAGULUM.

To prove whether or not these conclusions were well founded, I took a quantity of cow's milk, in which the proportion of coagulum is considerable: and after having precipitated a pretty firm coagulum, by the addition of a small quantity of vitriolic acid, I re-dissolved that coagulum again entirely, by adding a greater quantity of the same acid. This solution was of a dark brown colour, which might have arisen from the greater quantity of the oily part of the milk, which so considerable a share of coagulum must have contained: for to become yellowish,  
brown,

*a)* page. 44

brown, reddish, or black, from the bare contact of any inflammable matter is a property of the vitriolic acid.

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Having ascertained this analogy, I thought myself justified in taking cow's milk, being most readily procureable, for the endeavour to determine the nature of milk in general; and, for this purpose I again directed my observations to the

#### SPONTANEOUS CHANGES OF COW'S MILK.

I took about lbiv. of pure cow's milk and I placed it at rest in the common temperature of the atmosphere, varying between  $60^{\circ}$  and  $65^{\circ}$  of Farenheit's thermometer.

I observed, as before, that a pretty thick cream collected itself uniformly upon the surface.<sup>a)</sup> I did not remove this, nor did I disturb the milk for some days; in which time it was entirely coagulated, having acquired some degree of acidity. The coagulum was

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not

<sup>a)</sup> page 41.

not so firm as when it was formed by rennet, or by the mineral acids: nor, on breaking this coagulum down, was the whey so freed from the other component parts of the milk, as it was when the artificial coagulating substances were made use of. This being retained still in the same situation, it emitted an acid odour, which became daily more and more disagreeable, until it gradually acquired that smell which is peculiar to putrid cheese. The whey now partook of the smell, and imparted to the tongue somewhat the flavour of cheese mixed with an acid.

## REMARKS ON DISTILLED MILK.

Here I would remark, that the first sensible spontaneous change of milk, is its becoming sour;\* nor after having distilled  
milk

\* This acid is commonly made use of in the bleaching of linen, for dissolving and extracting the earthy particles left in the cloth by the alkaline salts and lime employed for cleansing and whitening it. Butter-milk is preferred to plain sour milk or sour whey: this last is  
supposed



milk kept, in the same temperature of the atmosphere, to different periods between its natural and acrid state, could I ever discover the least proof of its having undergone a vinous fermentation: for I could never obtain the least of an inflammable, nor of a vinous spirit.† Neither from distilling it frequently

supposed to give the cloth a yellow colour. Dr. Home, in his ingenious treatise on this subject, recommends water acidulated with spirit of vitriol (in the proportion of about half an ounce, or at most three quarters of an ounce, to a gallon) as preferable in many respects to the acid of milk, or of the more directly vegetable substances. He observes that the latter are often difficultly procureable, abound with oleaginous particles, and hasten to corruption; whilst the vitriolic acid is cheap and pure, and indisposed to putrefy: that milk takes five days to perform its office, whilst the vitriolic acid does it in as many minutes: that this acid contributes also to whiten the cloth, and does not make it weaker though the cloth be kept in it for months. He finds that acids as well as alkalies extract an oily matter from cloth, and lose their acidity and alkalescency.

Neum. Chem. Works, by Lewis, p. 573. in a note.

† In Russia they have a method of preparing a very grateful fermented liquor from milk, I believe from mare's milk

quently after it was in a state of putrefaction, could I obtain the smallest particle of volatile alkali.

SPONTANEOUS CHANGES  
OF THE  
COMPONENT PARTS OF MILK SEPARATED  
FROM  
EACH OTHER.

I took another quantity of cow's milk, from which I collected the cream, after it had stood about thirty-six hours, and still more cream arose afterwards, which I likewise took away. I then encreased the heat of the skimmed milk to about  $100^{\circ}$  of Farenheit's scale ; and, by the assistance of rennet, I coagulated the cheefy part. I then broke the coagulum in pieces, by using considerable pressure, and I separated the cheese from  
the

milk, which they call *Koumifs*: I am entirely unacquainted with their peculiar mode of preparing it, nor do I know any thing more of the process, than that much agitation is necessary. I have been told that a paper on the subject is in the possession of the Royal Society of Edinburgh, written by an ingenious gentleman, a physician of Petersburg.

the whey. After I had clarified the whey, by repeatedly boiling it with the whites of eggs, I placed each, the whey, the coagulum, and the cream, in the common temperature of the atmosphere, to observe the changes which might ensue.

The cream, upon standing some days, seemed to ferment, and began to divide itself from the aqueous part or whey, which was collected with it on skimming it from the milk. Both the whey and the cream had become acid; but the cream, swimming on the surface, soon lost considerably of the acid taste, and acquired that smell and taste which the cheese acquired upon longer keeping: for the cheese was not changed so soon as the cream; but afterwards it became both of a sub-putrid smell and taste.

The whey, being well clarified, and evaporated to about one-third of its original quantity, and placed in a cool current of air, gave out some crystals, of a pyramidal form, to the sides of the glass vessel in which it was contained. I left it still for  
some

some time longer subjected to spontaneous evaporation, when the whole of the aqueous part was dissipated, and a considerable quantity of a brownish saccharine substance was left at the sides and bottom of the vessel, mostly crystallized.

OBSERVATIONS  
ON THE  
SACCHARINE PART.

This saccharine matter was not deliquescent in the common atmosphere, but wholly soluble in water, from which it could be obtained again in a similar form. It was likewise compleatly soluble in all the mineral acids without violent action, imparting a dark brown colour to the vitriolic acid; nor was it precipitated again by alkalies from either.

REMARKS ON THE MAKING OF BUTTER.

I next took a quantity of cream which I had collected from milk, after having left it at rest for about 36 hours; and by agitation in a large phial, I separated the butyraceous part. Upon taking the cork from  
the



the phial, a quantity of air seemed to rush out, attended with some little explosion. I immediately formed a conjecture, that this effect was produced by means of the extrication of air from the milk; which I knew had been denied by Dr. Young. I confess I was at that time more particularly led to think, that the Doctor had mistaken the fact, as I considered the experiment, from which he drew his conclusion, to have been by no means conclusive.

The Doctor put half a pint of cream into a glass vessel, from which he had exhausted the air; and he made butter in about twelve minutes, as readily as he had done when the vessel was full of air.\*

I

Now

\* Multi crediderunt butyrum factum esse fermentatione quadam, et aëris separatione; sed sequentia experimenta hujus contrarium demonstrant:

Cremoris Lactis selibram, in cirnea vitrea, ex qua aër exhaustus erat, misi, et butyrum eodem temporis spatio, quo in cernea aëre plena perfectum erat, scilicet intra duodecim minuta aliquando citius, aliquando tardius.

Young De Lacte, p. 15.

Now surely this experiment cannot be conclusive. A quantity of air sufficient to have filled the vacuum, which the Doctor had formed, and to have restored the equilibrium with the external air, might have been extricated; for the Doctor has given us no account of the state of the vessel after his experiment. He has not given us even a conjecture that the vacuum which he had formed remained, at the end of his experiment, as complete as he had formed it. Indeed I know not how this could have been proved, unless the vacuum formed had been so considerable, as to have rendered the restoration of the equilibrium evident, by the violent rushing in of the external air for that purpose.

I was undoubtedly obliged afterwards to abandon the idea, which I at first thought a just one; for I found that Dr. Young had drawn a right conclusion, although not from a decisive experiment.

I took a quantity of cream in a large  
phial

phial as before, and I corked the phial with a cork, which had a small quill open at both ends through the middle of it: I now tied firmly round the neck of the phial, including the cork thus pierced, a bladder which I had moistened, and from which I had forced as much air as possible: the bladder was pressed flatly down upon the cork. Now, putting my thumb upon the cork over the quill, and holding the phial in my hands, I, by agitation, separated in about ten minutes the butyraceous part as in the former experiment; and, on taking away my thumb, a small quantity of air made its escape through the quill into the bladder. But upon examining the butter with a thermometer, I found that in the process it had been encreased above  $10^{\circ}$  in its heat. Hence I concluded that in the former experiment as well as in this, the apparent extrication of air must have been merely the effect of the rarification of that air, which

the phial contained, and which must have been greatly encreased by the heat communicated from my hands to the phial, during the experiment.

I repeated the experiment, avoiding any contact by which heat could be communicated from my hands to the phial; for having prepared a wooden frame for my phial with two long handles at the ends, I held by these while I agitated the phial. Butter was formed as before, nor could I observe any appearance of air forcing its way into the bladder; although its heat had been encreased  $4^{\circ}$ .

This experiment appeared to me to be more conclusive than Dr. Young's; for I should have expected, did the effect really depend upon the extrication of air, if the force and uniformity of agitation were the same, that butter must have been sooner made in *in vacuo*: for in that situation there was certainly more space for that air to have occupied, which might have been set at liberty; as well as greater freedom allowed  
for



for its immediate extrication. Had the Doctor found it necessary to have altered the state of the air within the phial, it appears to me that he should have reversed his experiment, in order to have prevented the escape of the air of the cream, as much as he could, by the condensation of that air, in which it was to have been agitated.

I however think with him, that the formation of butter is not effected by the extrication of air. Is it improbable that it is effected by forcing the particles of butter during the agitation into a nearer contact, which continues permanent from their stronger attraction for each other, than for those particles of whey and cheese, from which they are separated? Is the heat essential for this change, or merely the effect of friction? Or is the process that of fermentation and the heat a consequence?

I repeated Dr. Young's experiments of making butter with acids, alkalies, lime-water, ardent-spirits, neutral salts, sugar,  
and

and various proportions of water, with results similar to those which occurred to him.\*

I found, that neither acids, alkalies, lime-water, alcohol, neutral salts, nor sugar, prevented the formation of butter, when added in the quantities mentioned by Dr. Young. But I found that the more diluted the cream was with lime-water, with ardent spirits, or with plain water, that the formation of butter was more retarded : and that either of those fluids, added in quantities much greater than the cream itself, entirely prevented the formation of butter.

This I thought might be merely owing to the dilution, supposing that the oily particles were too diffused for being collected in the form of butter. This opinion seemed to me to be strengthened, by the difficulty of collecting butter from milk itself, which I was not able to do, even after constant agitation for more than half an hour.

Butter,

\* Young De Laë, p. 15, et sequent:

Butter, when newly made, is of a mild pleasant smell; perfectly bland upon the tongue, and readily soluble in the heat of the mouth. It is always collected in a concrete form; and, on standing for some considerable time, it becomes highly rancid; and is then acrid to the taste.

COW'S MILK, WITH VARIOUS ADDITIONS.

I repeated some of those experiments, with cow's milk alone, which I had made to ascertain the analogy between the milk of ruminating and of not ruminating animals.\* I added the mineral acids, alkalies, rennet, and likewise vinegar, to separate quantities of the milk: and I found them all to possess the power of coagulating the cheesy part, as Dr. Young has asserted.

R E M A R K S.

As I could determine nothing satisfactory concerning the action of these, nor of several other substances, which possess the power  
of

\* page 44. 45.

of coagulating milk, I knew not how I could possibly draw any just conclusion, respecting the real nature of milk, from the prosecution of such experiments. I therefore was not anxious to extend my experiments to a repetition of all those, which Dr. Young had made with the stomachs of various animals, various vegetables, &c.\*

It

\* Dr. Young coagulated milk with the stomach of the common fowl, of the goose, of the duck, of the Guinea fowl, of the partridge, of the hare, and of the rabbit, all of which feed on vegetables.

Likewise with the stomach of the solangoose, which feeds on fish, particularly on herrings; and also with that of the hawk, which is entirely a carnivorous bird.

He found that the fourth stomach only of ruminating animals, as of the calf, of the lamb, of the kid, of the sheep, and of the cow, possesses this power of coagulating milk: that the crop of birds has no such power: but that both the gastric liquor and the stomach of abortive animals, as well as of infant animals which have taken no food, will produce coagulation in milk: which he proved by experiments made with the stomach of a calf, of a human foetus, and of a young rabbit.

Certain live fish, he observed, coagulate milk, but that when dead, they lose the power. Among vegetables,  
Dr.



It is as yet undetermined upon what the property of coagulating milk in such substances depends. It has been asserted positively,

Dr. Young said that he found none, with which he could coagulate milk, except the purple flowers of the artichoke infused in some cold water, to which a little common salt had been added. That neither the leaves nor any other part of the artichoke, although treated in the same manner, possess this property: nay that the purple flowers themselves infused in boiling water lose it entirely, yet that infused in cold water they occasion a stronger coagulation in milk almost boiling, than in cold or tepid milk.

Jussieu described two species of lady's bed-straw, the *gallium saxatile supinum, molliore folio*, and the *gallium saxatile minimum supinum et pumilum*, as possessing the property of coagulating milk, and from this supposition the French call the latter *caille lait*, and the English call it cheese runnet. But Dr. Young asserts that upon diligent examination it did not appear to him, that those plants possess such a property.

Young De Lacte, p. 19, & sequent:

It has likewise been discovered that the liver, the heart and lungs of a turkey have a similar power of producing a coagulation in milk.

Crit. Review for Dec. 1784. p. 402.

There is directed in the Pharmacopoeia of the London College a *serum aluminosum* made by boiling ʒij. of allum reduced to powder in lbi. of cow's milk.

Like-

fitively, that such property in rennet, in different flowers, &c. is owing to the latent acid which they contain.\* But I am inclined to think that the contrary is true beyond doubt. We know that alkalies have the same power, though possibly by a different action; for the coagulum formed by them swims on the surface of the whey, while that which acids form sinks to the bottom.

But if this coagulating power depend upon an acid latent in rennet, in the gastric liquor,

Likewise a *serum scorbuticum* made by boiling ℥iv. of the juices of scorbutic herbs in lbj. of cow's milk. And in the Pharmacopoeia of St. George's Hospital a *serum sinapium* is directed, which is made by boiling ℥ss. of bruised mustard seeds in lbj. of cow's milk mixed with as much water.

New cow's milk suffered to stand for some days on the leaves of butterwort (*pinguicula*) or sundew, becomes uniformly thick, slippery and coherent, and of an agreeable sweet taste, without any separation of its parts. Fresh milk added to this is thickened in the same manner, and this successively. In some parts of Sweden, as we are informed in the Swedish memoirs, milk is thus prepared for food.

Neumann's Chem: Works by Dr. Lewis, p. 573.

\* Chemical Dictionary, called Macquier's.

liquor, in the stomachs of animals, &c. how happens it that rennet by means of its imperceptible and undiscoverable acid, should always form a firmer coagulum, than the most concentrated mineral acids.

Since the fact is so, I must confess that I cannot coincide with the opinion, that the power of those coagulating substances depends upon an acid merely, although I dare not venture an idea of their real action.

#### CHEMICAL ANALYSIS OF MILK.

Upon a review of the observations and of the results of the experiments which are already related, I might perhaps be allowed to draw some conclusion respecting the nature of milk. But, although I am well persuaded, that analysis by means of fire is often a fallacious method, of acquiring an accurate knowledge of the nature and properties of any matter, in its naturally combined state: yet as such analysis might in some instances lead us to a distinction between animal and vegetable matter; so I chose to prosecute this kind of enquiry,

hoping that I might possibly have ascertained some facts, which might better have enabled me to determine the precise nature of milk.

#### DISTILLATION OF COW'S MILK.

I took a quantity of fresh drawn milk, and put it into a retort, which I placed in a sand pot gently heated; and, by tying a bladder moistened and freed as much as possible from air around the neck of the retort, I obtained by its distension a proof that fixable air is the first component part of milk, that is set at liberty by means of heat.

I would observe here, that boiled milk is by no means liable to become acid, so soon as milk not boiled; and I am inclined to be of an opinion with those who think that this is owing to the extrication of its air.\*

And

\* Physicians have supposed that there is a *spiritus rectior* in milk, which evaporates by boiling; but perhaps this is merely a conjecture. Milk is found to yield more fœces when boiled than when taken without boiling.



And perhaps it might be possible, could all the air of milk be extricated by any means, that it would then lose the property of becoming acid. Is it allowable to conjecture, that that power of coagulating milk, which exists in such a variety of substances, depends upon a combination formed by the union of some one principle common to all with the fixable air of milk?

Rennet does not coagulate milk heated to a certain point much below its boiling point, and when nothing can have escaped  
from

ing. Dr. Cullen supposed that this might be owing to its component parts being more thoroughly blended by heat: as milk exposed for any length of time to the air must have advanced somewhat towards a spontaneous separation. As it seems evident, by the froth on the surface, that a considerable quantity of air is detached when milk is boiled (which is fully proved by the experiment above related) and as the air is the chief instrument of fermentation in bodies, so after this process he concluded that milk was, on these accounts, less liable to acescency.

Cullen's Mat: Med: Dublin edit: p. 95.

Young De Lacte, p. 33:

from the milk but air. And in the common preparations of wine and vinegar whey, we see that milk is best coagulated at that instant when the milk is rising from the distension of its remaining rarified air, then just ready to escape upon the bursting of the creamy film, which is formed on the surface of the milk.\*

However, the rennet losing its coagulating power at a certain point seems evidently either to show, that something has escaped from the milk, which is necessary for the rennet's action; or that rennet and other substances, as wine, vinegar, &c. must have a different mode of action.

Sugar mixed with milk in any considerable quantity likewise greatly retards its acid process; possibly from the disposition

\* Plurimis experimentis comperimus, lac, ultra centum et triginta gradus calefactum, nunquam coagulavisse, ab admisso coagulo animali; contra, coagulum vegetabile, fortius lac bulliens quam lac tepidum coagulare.

tion that sugar has of first undergoing the vinous fermentation.

I removed the bladder from the retort, and luted a receiver to it; the fire being gradually encreased, a very considerable quantity of phlegm, somewhat of the smell of burnt milk, came first over into the receiver. This phlegm was perfectly clear, nor were there any evident effects from the addition of acids or of alkalies. I removed this, and again luted the receiver to the retort; and, by encreasing the fire, a little more phlegm came first over; then a citrine coloured acid liquor, which became darker and darker in colour. By a further augmentation of the fire, the retort was filled with a violently elastic white vapour, which, the luting being forced, I found to be inflammable, and of a very empyreumatic smell. This vapour burned like oil, at the opening which it had forced in the luting. But that part of the vapour which went into the receiver was condensed into the form of a black, or dark brown empyreumatic oil, swimming on the surface of the citrine coloured

loured liquor, and on that small quantity of phlegm, which came first over after the retort had been again applied. This vapour subsiding, I put the retort on the naked fire, and a vapour still more forcible was driven into the receiver, and there condensed as the last, into a black empyreumatic oil. At length, the retort being freed of this vapour, and still kept on the fire, until a part of it was melted, I removed the receiver, and took the remaining coal-like residuum from the remainder of the retort. This residuum was very light, spiculated, and beautifully shining. I could observe not the least appearance of volatile alkali through the whole process. I indeed thought, after having boiled the coal-like residuum in water, on adding one of the mineral acids to the water, that I observed some effervescence ; but the syrup of violets was not changed by this water ; and, from thence, I concluded that it contained no fixed alkali.



## DISTILLATION OF CHEESE.

I repeated this experiment with the caseous part separately; and the result differed only in the proportion of the products; except, as I thought, the acid liquor from the cheese was more acrid to the smell and taste, than that from the general residuum. I could observe no particle of volatile alkali in a concrete form, nor could I obtain any proof of the existence of fixed alkali in the residuum.†

D I S T I L L A T I O N  
OF THE  
S U G A R OF M I L K.

I again repeated this experiment with the sugar of milk, with a result but little differing from the former. And this similarity tends to shew, how little we ought

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† On distilling in a retort sixteen ounces of Dutch cheese, there arose seven ounces one drachm and ten grains of urinous phlegm, two ounces thirty grains of volatile urinous salt, and three ounces three drachms and a half of empyreumatic oil: the caput mortuum weighed two ounces fifty grains.

Neum: Chem: Works, by Lewis, p. 572.

to rely, in judging of the specific nature of different substances, upon chemical decomposition merely ; for the chief difference here was a greater degree of acridity, in the the citrine-coloured liquor obtained from cheese, than in that obtained from the sugar ; although the one undoubtedly partakes much of an animal, while the other is almost of a purely vegetable nature.

This analysis of the saccharine part of milk more particularly shews its similitude, to the sugar obtained from the sugar cane ;\* which yields, on distillation, “ a phlegm, an oily empyreumatic acid, a small portion of a coloured empyreumatic oil, and leaves a considerable quantity of residuous coal. In its natural state, it consists of an acid united with a large quantity of an attenuated and mucilaginous earth ; and with a certain quantity of sweet, and not volatile oil ; which is in a state perfectly saponaceous ; that is, entirely soluble in water by means of the acid.†

That

\* Fordyce's Elements of the Pract. of Phys. p. 39.

† Chemic. Diction. called Macquier's, Article Sugar.

That such an oil really exists in the sugar of milk, in its natural state, is in some measure shewn by the dark colour, which is produced by its solution in the vitriolic acid, the natural effect of an union of this acid with any substances which contain inflammable matter.

#### DISTILLATION OF BUTTER.

I next subjected butter to a similar test; and in this experiment, as in the former, a small portion of phlegm was first condensed in the receiver; but nothing further arose, until the fire was considerably increased. By the butter boiling for some time, it became of a brown colour, and perfectly transparent; but on removing it from the fire, as it became cool it again congealed and was once more opake. I luted the retort again to a receiver and greatly increased the intensity of the fire, when a small quantity of a reddish liquor arose together with a small quantity of a fluid empyreumatic oil, of a brownish colour. But, the fire in-

creasing in violence, the luting burst and the room was presently filled with an extremely acrid vapour; which occasioned a copious flow of tears, and a considerable defluxion of mucus from my nostrils; and so affected my respiration, that I was obliged to take the retort from the fire, and to leave the room immediately. This vapour being dissipated, I again renewed the attempt of obtaining an accurate analysis of butter, and I endeavoured to proceed with more caution. I first obtained a small quantity of a reddish liquor, and of a brownish fluid empyreumatic oil, as before; and afterwards a vapour arose, which, when condensed, concreted into a solid form, like to boiled butter when cold. But my luting being secured, my flask retort now gave way from the great elasticity of that vapour, with which it was filled. I was subjected at this time to a greater inconveniency than before; the whole burst into a flame, which with some difficulty I extinguished; and was again obliged to flee to the fresh air for relief.

I will



I still made a third attempt at the same experiment; and I obtained rather more of the fluid empyreumatic oil, than in either of my former attempts; and afterwards some of the concrete oil, as in my last. But my flask gave way again at the neck, and the vapour was so troublesome, that, finding I must have been obliged to leave the room, I broke off part of the neck of the flask, and, directing its mouth towards the vent, I roused the fire to as great an intensity as I could, and left the whole for about three hours. On my return, I found a black coal-like residuum, shining and spiculated, at the bottom of the flask. But I saw no appearance of volatile alkali\*.

#### CONCLUSIONS.

I would now take a retrospective view of such observations, and of such results from the experiments related, as I consider to

\* The apparatus with which I made these experiments, was perhaps too small; nor have I had any opportunity of repeating them since, in one more calculated for the purpose.

have

have the chief weight in forming a general conclusion, respecting the precise nature of milk.

Milk, in its appearance, greatly resembles an emulsion formed by the *nucis oleosæ*, combined with some farinaceous or mucilaginous substance and water. Like such an artificial emulsion, it gives off a considerable proportion of its oil to the surface, and seems to differ from it only in possessing a component part, which, in certain circumstances and from certain additions, is coagulable. Yet, from this partial similarity, I think we might be led to conclude, that milk possesses, in some measure, an affinity to vegetable matter.

It's spontaneously becoming acid, and it's affording sugar are demonstrative of it's alliance to vegetable matter; for these are properties peculiar to the vegetable kingdom. Its butter or oily part, being a smooth substance, readily soluble with but little heat, and becoming rancid on being kept for any length of time, renders the analogy  
of

of this part of milk to the expressed oil of vegetables, not entirely unexceptionable. But the putrefactive change of its cheese or mucilage, must induce us to consider this part, as partaking somewhat of an animal nature.

*Beccarius* was of opinion that both the residuum of milk, and likewise its serum, contained no inconsiderable proportion of volatile alkali.\*

I confess that I have not been enabled to observe a grain of either volatile or fixed alkali in any experiment which I have made.†

Indeed

\* *Edinb. Med. Comm.* vol. 1. p. 161.

† “*Homburg* could discover no volatile salt either in a concrete or liquid form, from the distillation of breast milk. But he tells us that the *caput mortuum*, calcined and elixated gave a scruple of fixed alkali.”

“*Neuman* says, that the solid matter remaining after the distillation of twelve quarts of milk in *balneo mariæ*, adhered to the bottom of the retort in form of elegant shining black flowers, and seemed to have penetrated and united with the glass, and changed it into a substance

Indeed the opinion, which I have been induced to form with regard to the nature of milk, from the observations and experiments related in this attempt towards its investigation, would not lead me to the expectation of discovering either volatile or fixed alkali in the composition of milk. There appears to be nothing of an absolutely animal nature; nor indeed but a very small proportion of what is most allied to vegetable matter, (of the saccharine part) in the composition of milk. Hence, I am inclined upon the whole to conclude, that milk, in the aggregate, is neither of a vegetable nor of an animal nature; but that it is intermediate

stance resembling porcelane. This residuum, calcined and elixated, yielded a portion of alkaline salt."

"In Du Hamel's *Historia academiciæ scientiarum*, it is said that the fixed salt obtained from the caput mortuum of milk is not alkaline: I am pretty certain says Neumann that mine was, for it turned syrup of violets green, and threw down a reddish precipitate from a solution of mercury sublimate."

Neumann's Chem: Works, by Lewis, p. 570. 571.



intermediate, partaking somewhat of the nature of both.

I would remark that the cheese, which I submitted to the process of distillation, was never that, which had been absolutely decayed by age. And hence perhaps arose that want of volatile alkali in my experiments, which Beccarius was led to think is always present, especially in the caseous part of milk.

I always subjected to experiment that cheese which I had made myself, and which I did not use until it had acquired a putrid smell and taste similar to that, which unprepared or what is called new or cream cheese constantly acquires, on keeping, even a short time.

I considered the experiment with old cheese to be unfair; because we know, after a certain time, that that becomes a *nidus*, and the *pabulum* of myriads of *animalculæ*; thousands of which are undiscoverable, but by the assistance of glasses. Here, *a priori*, we might expect to find volatile alkali; but this can by no means amount to a proof that volatile alkali exists as a

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component part of milk, or of the parts of milk, after they have undergone every change, which of themselves they can undergo.

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I might have concluded my experiments here, but Dr. Webster, one of the Secretaries to the Harveian Society, when he gave out this subject for investigation, remarked that it would be acceptable to the Society to receive any experiments, which might tend to determine the extent of analogy between milk and blood. I therefore prosecuted the subject still further, and in the next place, I directed my attention to such experiments, as seemed to be best calculated to enable me to solve the question.

I expected that I should be able to draw conclusions, which might in some measure determine the truth or fallacy of such supposed analogy, by comparing the spontaneous changes, which occur in each of the fluids, and by observing the effects of various similar additions, upon their supposed analogous parts.

COM-

ON MILK.

83

COMPARATIVE EXPERIMENTS

ON MILK AND BLOOD

IN

THEIR NATURALLY COMPOUNDED STATE,

AND

ON THEIR GENERAL COMPONENT PARTS

SEPARATED FROM EACH OTHER.

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In

In order to render the comparison as clear as possible, I shall arrange the results of such experiments as are similar in opposite pages: beginning with describing the effects which took place on the addition of various articles

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M I L K.

E X P E R I M E N T   I.

Mineral acids coagulated milk newly taken from the cow, with separation of its whey.

E X P E R I M E N T   II.

Rennet, added to milk newly drawn, prevented that change, which is common to milk at rest, by presently producing that alteration, which spontaneous acidity only can effect naturally, after the milk has been kept for some time.

Com-



cles to milk and to blood separately, in their naturally compounded state as they are taken from the animal, and with pointing out the changes to which they are spontaneously subject.

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## B L O O D.

## E X P E R I M E N T I.

Mineral acids coagulated blood just drawn, without separation of its serum.

## E X P E R I M E N T II.

Rennet unsalted, when added to freshly drawn blood, neither produced any change, nor impeded that change which is natural to blood when placed at rest.

Com-

## M I L K.

## E X P E R I M E N T    III.

Common salt, added to milk, did neither retard its usual separation of cream; nor prevent its becoming acid and coagulating spontaneously.

## E X P E R I M E N T    IV.

Vinegar, added to milk warm from the cow, by coagulating its caseous part, produced a separation of its whey.

## E X P E R I M E N T    V.

I caught about lb ii. of milk as it was drawn from the cow, and I observed that a halitus or thin vapour escaped from its surface: on standing at rest in a temperature of about  $55^{\circ}$ , it gave off a thickish cream to the surface. Being retained yet longer, it became acid, and then, and not  
until

## B L O O D.

## E X P E R I M E N T    I I I .

Common salt, added to blood newly drawn, prevented that coagulation to which blood unmixed is spontaneously subject, notwithstanding it was exposed to the usual circumstances of air, rest, &c.

## E X P E R I M E N T    I V .

Vinegar, added to blood newly drawn and in its fluid state, anticipated its natural coagulation, and prevented a division of its serum, by congealing the whole mass into the consistence of a jelly.

## E X P E R I M E N T    V .

I took likewise about lbii. of blood just drawn from an ox; and I observed that a halitus, or thin vapour likewise escaped from its surface. I placed the blood at rest in a temperature also of about  $55^{\circ}$  to observe the spontaneous changes that it might undergo; and presently, as is usual, on its becoming cool, it began to coagulate  
uni-

## M I L K.

until then (in about fifty hours) it coagulated. But no separation of whey or serum succeeded, until this coagulum was much divided by force. The milk first became acid, as I have mentioned; and on being kept acquired, from the evaporation of some of its aqueous part, a firmer consistence, approaching more to the appearance of cheese; and likewise that sub-putrescent state, to which cheese is subject, from being kept for any length of time.

## E X P E R I M E N T VI.

I assiduously agitated milk, with a stick, for a considerable time, when it shewed not the least disposition of parting with any share  
of



## B L O O D.

uniformly. But, on standing yet longer, the *crassamentum* or the coagulating part combined with the red particles began to give off in every direction the serum or aqueous part; and freeing itself equally from all contact with the vessel in which it was contained, it was at length entirely suspended in this serum. The surface of the *crassamentum* was of a florid red colour, but the mass was darkly red or black at the bottom, where it was secluded from the action of the air. The blood still kept in the same temperature, shewed no sign of its having become acid; but, on the contrary, putrid, increasing in putridity, until it became very offensive, the whole being at length one putrid mass.

## E X P E R I M E N T VI.

From a portion of blood, fresh drawn, I took, by stirring it with a stick, as I had stirred the milk, that part which thus separated

## M I L K.

of its coagulable part ; but, when suffered to be again at rest, it underwent every change in the same manner as did that milk which had not been agitated.

## E X P E R I M E N T VII.

I separated very cautiously, in the next place, the cream, the cheese, and the whey of milk, from each other. By agitating the cream I formed butter ; I separated the cheese from the whey, by the assistance of rennet ; and afterwards I clarified the whey, by boiling it with the whites of eggs.

NOTE.

## B L O O D.

rated, is apparently fibrous, and which is the spontaneously congeling part of blood; thence called the coagulating or coagulable lymph. And by repeatedly washing this with water, I rendered it white, having freed it from all the red particles. The red particles of the blood remained suspended, or rather sunk in the serum after this coagulating lymph was taken away, without the least tendency to coagulate.

## E X P E R I M E N T VII.

I likewise separated as accurately as I possibly could, the coagulating lymph, the red particles, and serum of a quantity of recent ox blood. I took the coagulating lymph from it, as before, and rendered it white by repeated washing; separating as cautiously as possible, the red particles from the remainder, after it had stood at rest for some short time.

N 2

From

## M I L K.

## N O T E.

In many parts of Devonshire they have a peculiar way of preparing cream, which when prepared, they call clotted or vulgarly *clouted* cream. Their method is to strain the newly drawn cow's milk into a glazed earthen pan which will stand the fire, and then to place it at rest for 24 hours. They then put the pan upon a clear charcoal fire, as gently as possible, lest they should disturb the film of cream now risen to the surface of the milk. Whenever the milk begins to swell, and the surface to heave up, they take it from the fire with as much caution as they placed it on, for if they break the swelling surface their labour is fruitless. They permit it again to stand for twenty-four hours, when they take a rich cream from the top in clotty masses, which is held in high estimation as a luxurious treat.

## BUTTER



## B L O O D.

From another portion of blood which I suffered to coagulate, and to form a spontaneous separation of its serum, I drew off, by means of cotton (used as a syphon that I might not disturb the mass of *crassamentum*) a quantity of serum, which readily passed through the filtering paper folded double.

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## E X P E R I M E N T S

ON THE PARTS

OF

M I L K   A N D   B L O O D.

I subjected these parts of milk, thus separated to experiments, as follow; and the three separate parts of blood to similar experiments, as on opposite pages.

RED

## BUTTER.

## EXPERIMENT VIII.

I took a portion of butter, and placed it upon an iron plate heated to redness and found it to be inflammable. Its fluid part being dissipated, a black coal like residuum was left remaining. The odour with which this inflammation was attended, was like that which is produced by burning cheese.

## EXPERIMENT IX.

To another portion of butter I added the smoaking nitrous acid, upon which no violent action ensued. A sea-green colour was produced upon its surface which went off as the fumes of the acid escaped. The butter was left undissolved upon the surface of the acid, of its natural colour or rather whiter, in the form of a thick mucilage or oil. The acid was perfectly clear underneath it; neither was there any decomposition nor turbidness on adding water to the acid ;  
nor

## RED PARTICLES.

## EXPERIMENT VIII.

I likewise took a quantity of the red particles of blood, and I exposed them in the same manner as I had exposed the butter, to the action of fire, and with a similar result, except that the odour produced in this experiment was like the smell from the burning of raw flesh.

## EXPERIMENT IX.

I likewise added the smoaking nitrous acid to another portion of the red particles of blood: a sea-green colour was immediately produced on their surface. The action of the acid was particularly violent. The mixture at bottom was of a dark brown colour, and was covered thickly with air bubbles. These and the green colour disappeared with the fumes of the acid, and there remained a solution of the red particles of a dark brown colour, which, on  
the

## B U T T E R.

nor any change of colour on the addition of alkalies.

## E X P E R I M E N T X.

From muriatic acid with butter there ensued no evident effect.

## E X P E R I M E N T XI.

Vitriolic acid dissolved butter partially only, the solution being of a reddish brown colour. Some little precipitation took place on the addition of water, but no change of colour, nor re-solution with alkalies.

BUTTER.



## RED PARTICLES.

the addition of water was rendered of a lighter tinge and turbid ; and some precipitation succeeded. On the addition of common fixed alkali, the solution was again compleat, and of a bright colour, like mountain wine. The caustic fixed alkali rather increased the decomposition, and did not alter the colour.

## EXPERIMENT X.

Red particles, with muriatic acid, produced no violent action, nor green colour, but there was a dark brown partial solution, having a kind of coagulum upon its surface. No precipitation or change took place upon the addition of water nor of alkalies.

## EXPERIMENT XI.

From red particles, with vitriolic acid : no violent action but a dark brown colour was produced, the particles like a coagulum swimming in the middle at first, but these were afterwards more dissolved.

O

RED

BUTTER.

EXPERIMENT XII.

Alcohol produced no evident change on butter.

EXPERIMENT XIII.

Æther did not make any immediate change upon butter; but, after some time, a good deal divided its particles.

EXPERIMENT XIV.

Butter was rendered somewhat of the appearance of dissolved soap, with caustic alkali, forming a pretty uniform white mixture.

BUTTER

## RED PARTICLES.

There was some little decomposition when mixed with water, and a re-solution with either mild or caustic alkali, but no change of colour.

## EXPERIMENT XII.

Red particles, with alcohol, formed a pretty uniform mixture of a red colour. The spirit evaporating a thick brown powder-like residuum] was left, of the smell of cherry brandy.

## EXPERIMENT XIII.

From red particles with æther, an immediate coagulation ensued.

## EXPERIMENT XIV.

Red particles, with caustic alkali, formed a pretty uniform mixture of a bright red colour, becoming more and more of a fine deep brown. When evaporated, the residuum had somewhat the appearance of jelly.

## B U T T E R.

## EXPERIMENT XV.

No evident change was produced on butter by common fixed alkali except a division of its particles. The ebullition on adding vitriolic acid to this alkali, after the butter had remained in it for 36 hours, was not in the least more violent than is common, nor did any decomposition ensue.

BUTTER



## RED PARTICLES.

## EXPERIMENT XV.

The common fixed alkali, mixing uniformly with red particles, rendered the mixture of a bright red colour. On the addition of water, still a bright red colour existed, but some darker red particles were precipitated. Vitriolic acid being added, a foamy decomposition immediately took place, with violent ebullition. The foam remained still upon the surface, after the ebullition had ceased, and the colour was destroyed. This mixture of red particles in common fixed alkali, fell in water to the bottom, in the form of a drop; but on a little agitation, mingled uniformly, producing a bright red colour. But, dropped into a mixture of vitriolic acid and water, it did not sink, but an ebullition and a gradual and partial mixing ensued, some dark red particles precipitating.

RED

## BUTTER.

## EXPERIMENT XVI.

Butter always possessed the surface of water.

## CHEESE.

## EXPERIMENT XVII.

Cheese, with fmoaking nitrous acid, formed a compleat solution. No decomposition took place with water and alkalies ; but a greenish yellow colour was produced.

CHEESE

## RED PARTICLES.

## EXPERIMENT XVI.

Red particles mixed freely with water, and sunk to the bottom when decomposed or separated.

## COAGULABLE LYMPH.

## EXPERIMENT XVII.

The coagulum of blood, with smoking nitrous acid, occasioned at first ebullition and some few air bubbles, and immediately afterwards a compleat solution took place. This being mixed with water, a decomposition ensued, and a very pale greenish colour was produced, which was not changed by caustic fixed alkali, but the decomposition was encreased, the separated part swimming on the surface, or being pretty generally diffused. With common fixed alkali, a re-solution took place, and the mixture was of a bright cinnamon colour.

COA-

## C H E E S E.

## E X P E R I M E N T XVIII.

Cheese in muriatic acid formed a solution of a bluish cast. No decomposition with water nor alkalies, nor any change of colour ensued.

## E X P E R I M E N T XIX.

A compleat solution of cheese was formed in vitriolic acid of a reddish brown colour, but no precipitation nor decomposition nor change of colour ensued on the addition of alkalies or water.

## E X P E R I M E N T XX.

Cheese with æther was rendered somewhat tough.



## COAGULABLE LYMPH.

## EXPERIMENT XVIII.

Muriatic acid with the coagulum of blood, produced no violent action but a transparent solution of rather a purple colour. Decomposition and precipitation were the consequence of an addition of water, and a re-solution ensued from either caustic or common fixed alkali being added, but no change of colour.

## EXPERIMENT XIX.

The coagulum of blood with vitriolic acid, occasioned no violent action, nor was it dissolved in that medium, but the coagulum became somewhat swelled and of a clear brown jelly, or candied appearance.

## EXPERIMENT XX.

Coagulum with æther was rendered only a little hardened and somewhat corrugated.

C H E E S E.

E X P E R I M E N T XXI.

Cheese with alcohol, was similarly affected as by æther.

E X P E R I M E N T XXII.

A division of particles, but not a solution of cheese, was produced by caustic alkali.

W H E Y.

E X P E R I M E N T XXIII.

The clarified whey of milk might always be evaporated, with or without heat; and in either way without coagulation, leaving a saccharine residuum.

E X P E R I M E N T XXIV.

The whey of milk and smoaking nitrous acid immediately united, as freely as that acid and water; and with no evident effects.

WHEY.

## COAGULABLE LYMPH.

## EXPERIMENT XXI.

Coagulum with alcohol was acted on in a somewhat similar manner as by æther.

## EXPERIMENT XXII.

Coagulum with caustic alkali formed a complete solution; a decomposition taking place on the addition of an acid.

## SERUM.

## EXPERIMENT XXIII.

The most pure serum of blood, that I could collect, always coagulated by heat after the evaporation of a most trifling proportion of its more watery part: when it wore the appearance of a tough transparent jelly; and was somewhat sweetish or saline to the taste.

## EXPERIMENT XXIV.

Smoking nitrous acid immediately coagulated the purest serum of blood, rendering it opaque, and of a light yellow colour.

108 DISSERTATION

W H E Y:

EXPERIMENT XXV.

No change on whey took place from the addition of muriatic acid.

EXPERIMENT XXVI.

No change on whey ensued from the addition of the vitriolic acid.

EXPERIMENT XXVII.

Caustic alkali did not alter the appearance of whey.

EXPERIMENT XXVIII.

No change was effected on whey by common fixed alkali.

EXPERIMENT XXIX.

Alcohol produced no evident effects on whey.

WHFY.



## S E R U M.

## E X P E R I M E N T XXV.

Muriatic acid immediately coagulated the serum of blood, rendering it opake and white.

## E X P E R I M E N T XXVI.

With vitriolic acid, exactly similar effects were produced on serum as with the muriatic.

## E X P E R I M E N T XXVII.

Caustic alkali effected no change on the serum of blood.

## E X P E R I M E N T XXVIII.

Common fixed alkali effected no change on the serum of the blood.

## E X P E R I M E N T XXIX.

An immediate turbidness and some precipitation ensued from the addition of alcohol to the serum of blood.

SERUM.

## W H E Y.

## E X P E R I M E N T   X X X .

Rennet mixed readily with the whey of milk, without effecting any change ; nor by the addition of rennet, alcohol, the alkalies or the acids, was the whey deprived of its disposition to evaporate, with or without heat.

## E X P E R I M E N T   X X X I .

Butter became rancid on keeping it for any length of time.

## E X P E R I M E N T   X X X I I .

Cheese became harder, on the escape of that aqueous part, which had not been sufficiently pressed from it when made ; and it likewise became, in a manner, putrid, from long keeping.\*

## E X P E R I M E N T   X X X I I I .

Whey acquired an acidity from being kept long.†

\* See note I. p. 112.   † See note II. *ibid*.

## S E R U M.

## E X P E R I M E N T   XXX.

Some turbidness ensued upon adding rennet to a portion of the serum of blood; but neither rennet, alcohol, nor the alkalies, impeded the coagulation of serum, when heat was applied.

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E X P E R I M E N T   XXXI.

The read particles of blood became putrid on being kept any length of time.

## E X P E R I M E N T   XXXII.

The coagulum of blood became hard dry, semi-transparent, and putrid, from being long kept.

## E X P E R I M E N T.   XXXIII.

The serum of blood became putrid from long keeping.

In

## NOTE I.

Sweet cheese shaved thin, and stirred with boiling hot water, changes into a tenaceous slime, which does not mingle with the liquor. Worked with fresh parcels of hot water and then mixed upon a hot stone, with a proper quantity of unslacked lime, into the consistence of a paste, it proves a strong and durable cement for wood, stone, earthen ware and glass. When thoroughly dry, which it will be in two or three days, it is not in the least acted upon by water. Cheese barely beaten with quick-lime as directed by some of the chemists for luting cracked glasses, is not near so tenacious.

Cheese, prepared as above, is recommended in the Swedish memoirs to be used by anglers as a bait. It may be made into any form, is not softened by the water, and is liked by the fishes.

Neumann's Chem: Works by Dr. Lewis p. 573.

Haller: El: Phys: tom. vii. lib. xxviii. p. 41.

## NOTE II.

Sour whey is used as an acid, perforably to the directly vegetable, or the mineral acids, in some of the chemical arts; as for dissolving iron, in order to the staining of linen or leather.

Neumann: ibidem.



## CONCLUSIONS.

In order to form a right judgement of the truth or fallacy of any hypothesis, it is certainly the most candid way to ascertain in the first place what circumstances favour, and what circumstances can be urged against it, and then, by a comparison of the favourable and unfavourable circumstances, reason must direct us to fix some determinate conclusion.

Following this plan, I will now take a fair and candid view of the leading facts, which have occurred to me from the experiments, which have been related. And perhaps I may be enabled to form from thence some conclusion respecting the analogy of milk and blood.

First, in respect to the circumstances, in which they agree:

Milk and blood appear to be homogeneous fluids, when first taken from the animal; while warm, they both give off from their surface a halitus or thin vapour. *a)*

Q

Acids

*a)* Exp. 5.

Acids added to either, in this state, coagulate them.*a)*

They both contain three parts, which are easily separable from each other; one of which, from either fluid is more inflammable than the other two.*b)*

Smoaking nitrous acid produces a green colour upon the surface of either butter, or of the red globules of blood, which are the supposed analogous parts; which green colour goes off from both, as the fumes of the acid escape.*c)*

Vitriolic acid effects a partial solution of both butter and red globules, and on the addition of water to either, some little decomposition takes place.*d)*

A uniform mixture may be formed with caustic alkali and either red globules or butter.*e)*

The coagulum of blood and cheese are both completely soluble in smoaking nitrous  
and

*a)* Exp. 1.      *b)* Exp. 5, 6, 7, 8.      *c)* Exp. 9.  
*d)* Exp. 11.    *e)* Exp. 14.

and in muriatic acid; and both incline to putridity.*a)*

The serum of blood, nor the whey of milk was affected by caustic, nor by common fixed alkali.*b)*

The changes which take place in common on the application of heat, in the serum of blood, and in the whey of milk, were not impeded in either by the addition of rennet, alcohol, nor of alkalies.*c)*

These are the chief circumstances in which the experiments related point out a similarity between milk and blood.

Now, against a similarity, it may be urged, that a halitus or thin vapour likewise escapes from freshly made urine, between which and milk so great an analogy has not been conjectured.

That although the serum of blood be prevented from separating, by the addition of mineral acids and of vinegar to blood, yet

Q 2 the

*a)* Exp. 17, 18, 32. *b)* Exp. 27, 28. *c)* Exp. 30.

the addition of either of those acids to milk produces a separation of whey. *a)*

That although the natural change, the spontaneous coagulation of the blood be not prevented by the addition of unsalted rennet; yet the natural change, the coagulation of milk, is, by the addition of such rennet, greatly anticipated. *b)*

That although common salt prevents the coagulation of blood, when exposed to the common causes of its coagulation; yet it neither destroys the coagulating power of acids nor of rennet upon milk, nor its spontaneous coagulation. *c)*

That although blood and milk change from their homogeneous appearance spontaneously, yet their changes bear no resemblance to each other: for the first change of blood is coagulation, which takes place as soon as it becomes cold, while the most nearly related natural change to that in milk requires many hours: nor can it depend  
upon

*a)* Exp. 1.   *b)* Exp. 2.   *c)* Exp. 3.



upon the same cause, since the change in milk is effected by means of a prior change in the whole fluid, the change to an acid state.*a)*

That inflammability being a property of substances, between which, no one could suspect any other similarity, is not sufficient of itself to determine an analogy between butter and the red globules of blood; especially as the difference of smell, from their inflammation, evinces some difference in their nature.*b)*

That by the agitation of milk, in any state, no such collection of the coagulable part ensues as from the agitation of newly-drawn blood.*c)*

That the green colour produced by smothering nitrous acid, upon both butter and the red particles of blood; *d)* the partial solution of both in vitriolic acid; *e)* and the uniform admixture of both with caustic alkali, *f)*  
can .

*a)* Exp. 5. *b)* Exp. 8. (*c* Exp. 6. *d)* Exp. 9.

*e)* Exp. 11. *f)* Exp. 14.

can have but little weight ; since a similar green colour is likewise produced by mixing the same acid and water ; since butter is not soluble in that acid like red particles ; *a*) since no evident effect is produced by muriatic acid on butter, as on red globules ; *b*) since the partial solution of butter in vitriolic acid, decomposed by water is not restored again by alkalies, as is a similar decomposition of red particles ; *c*) since there is no evident change upon butter with alcohol, while the same menstruum mingles pretty freely with red particles, and, on being evaporated, leaves them changed from the appearance, which they had before such mixture ; *d*) since the action of æther is so different upon red globules and butter ; *e*) and since butter, by its swimming on the surface of milk itself and upon water, together with its appearance and unctuous feel, shews itself to be an oil ; while  
the

(*a* Exp. 9. (*b* Exp. 10. (*c* Exp. 11. *d*) Exp. 12.  
*e*) Exp. 13.

the ready diffusibility of the red globules through water, and their sinking in water, when decomposed, determine them to be by no means an oil.*a*)

It may likewise be urged, that although cheese and the coagulum of blood be similar, in respect to their solubility in smoking nitrous, and in muriatic acid, yet the decomposition of one on the addition of water, &c. and not of the other,*b*) shews a difference in their nature ; to which, the complete solution of cheese in vitriolic acid, while that acid produces no change on the coagulum of blood, adds a proof : *c*) which is still strengthened by the complete solubility of the coagulum of blood in caustic alkali, while that menstruum only divides, not dissolves the cheese.*d*)

That the coagulation of the purest serum of blood at all times upon heat being applied, and the effects of the mineral acids,  
and

(*a* Exp. 16. *b*) Exp: 9, 10. *c*) Exp. 19. *d*) Exp. 22.

and of alcohol upon the serum of blood, being effects to which the whey of milk is never liable from the same applications: *a*) so must every idea of their relation be evidently subverted.

I would remark here indeed, that I am inclined to think that the spontaneous congelation of the coagulating lymph of blood taking place as the blood becomes cool, points out an essential difference between that part and the coagulated lymph or serum, which is congealed by heat.

The putridity of the red particles of blood, opposed to the rancidity of butter. *b*)

The putridity of the serum of blood, opposed to the acidity of the whey of milk. *c*)

And likewise the putrid tendency of the coagulum of blood, opposed to the subputridity of cheese, *d*) may all be urged against the opinion of analogy.

Upon

*a*) Exp. 23, 24, 25, 26, 29. *b*) Exp. 31. *c*) Exp. 33.

*d*) Exp. 32.



Upon the whole, I am inclined to conclude, that there exists no further analogy, between milk and blood, than in the divisibility of each, when recent, into its three great component parts.

Such agreement in so accidental a particular, can by no means, in my humble opinion, vindicate the idea of their analogy, when we speak of their nature and properties.

Blood gives no proof of any, but of an animal, while milk is chiefly allied to a vegetable nature.

Had not my endeavours to obtain a sufficient quantity of chyle, or of the milk of some entirely carnivorous animal been fruitless, I most certainly should have extended my investigation further than I have had it in my power to do, without such acquisitions. I could never obtain any of the former, in a sufficient quantity for experiment, nor indeed of the latter, except in so small a quantity as obliged me to confine my experiments to too few in number, for ascertaining any determinate idea of its nature.

R

It

It is asserted that the milk of such an animal is alkalescent.\* That the bitch from which I procured milk was fed wholly on flesh, is highly probable, because she was of the mastiff kind, and the property of a butcher, who lived surrounded by others of the same business. I found that her milk mixed with the syrup of violets produced a greenish colour, a test which in general is esteemed sufficient to prove its alkalescency. But having rendered syrup of violets red, by the addition of only one drop of vitriolic acid, I could only dilute, not destroy that red colour, with bitches milk, although I added it in a quantity greater than double that of the syrup of violets. Had it been of an  
alkaline

\* “ Si folis vegetabilibus, lac acescens ; si vero carne, nutriatur canis, alcalinum est, adeo ut recens lac chartæ succo caryophilorum imbutæ viridem colorem sæpe inducat.

“ Canem per septimanam alui, et ejus lac simillimum lacti caprino inveni ; acescens fuit. Eandem canem per aliquot dies carne alui, et plane alkalescens fuit.”

Young De Lacte, p. 53, 55.

alkaline nature, I should have expected, not only that the red colour would have been destroyed, but that a green colour would likewise have been produced. Upon this single experiment however I would not presume to deny that such milk is in some degree alkalescent. It certainly differs from the milk of those animals, the milk of which I had before examined, as it is not immediately coagulable on the addition of even mineral acids, nor indeed by rennet, nor even decomposed by such additions except heat be applied: it is of a disagreeable flavour; it appears to be a thick milk, and gives off rather a considerable quantity of cream.

ON THE  
IMMEDIATE ORIGIN OR SOURCE  
OF  
M I L K.

The peculiar nature of milk, and the undeniable evidence, which we have, of the many varieties, that it is liable to, ac-

R 2 cording

cording to the different properties of the *ingesta*, have induced some to conclude, that milk is nothing more than chyle conveyed from the intestines to the breasts, and that it is there separated unaltered \*.

Some authors argue, as certain nurses afford two pints of milk a day †, and certain cows sixty, that such a quantity could not be contained in the vessels, nor if the milk were of the blood, that it could be taken away without danger. That nurses themselves observe, if they use warm drink, that

a co-

\* “ Altera opinio, scilicet Lac, ex novo chylo recens in sanguinem ingresso, oriri, magis est probabilis.”

Young de Lacte, p. 55.

“ Lac est chylus, non vero sanguis, immutatus.”

Hoffm. oper. om. tom. i. p. 80.

“ Lac, quod nihil aliud est, quam chylus, &c.”

Ibid. p. 107. 469.

See also Borehaav. Prax. Med. tom. i. p. 171.

Hall. El. Phys. tom. vii. lib. xxiv. p. 61, 62. lib. 28.

p. 23.

† Some women have been known to yield a much greater quantity than this, even over-and-above that, which was necessary for the nourishment of their infants.

Haller. ibid. p. 24.



a copious secretion of milk presently supervenes the taking of food \*. Others contend that the difference between blood and milk is very great ; the one being aced, and reducible into butter, cheese, and whey, while the other upon stagnation putrifies : and that, from the distillation of either of the three general component parts of blood, volatile alkali is produced, while neither of the component parts of milk yield any.†

I confess, that I cannot readily coincide in opinion with these authors, that milk is simply unaltered chyle. That it is not perfectly anamalized, but that it approximates some-

\* “ Hoc theorema pluribus argumentis demonstrari potest. Etinam dantur nutrices, quæ duas lactis libras quotidie emittunt : quædam ex vaccis in Frisia singulis diebus triginta pintas lactis, quæ sexaginta libras complent, reddunt : si vero lac esset sanguis, hic non tam copiosus in venis existeret, neque sine virium & vitæ detrimento posset amitti. Denique ipsæ nutrices animadvertunt, non multo post à pastu, calido sumpto potu, ingentem & sensibilem lactis ad mammas fieri adfluxum.”

Hoffm. oper. om. tom. i. p. 80:

Young de Lacte, p. 54.

† Young ibid. & p. 55.

somewhat nearly to the nature of chyle, must be indisputably granted. Yet it appears to me to be equally clear from doubt, that it cannot be merely chyle unchanged.

The quantity of milk, secreted through the day, bears, in many instances, a very large proportion to the quantity of ingesta taken : \* but it has been thought, that not much above two pints of chyle is prepared in general, from five or six of food. †

The generality of men both eat and drink more than women; nay many women themselves take as much food when no secretion of milk is required, as when they suckle; but no inconvenience arises in such instances, from so much chyle being taken in by the vessels: nor, if milk were in reality derived from the blood itself, could there

\* Bos, intra viginti quatuor horas, libras quadraginta & sex graminis comedens, dabit triginta & octo libras lactis."

Boerhaav. Prax. Med. lib. I. p. 171.

† Haller. Elem. Phys. tom. vii. lib. 28. p. 25.

there be danger from any flow, however copious, in the way in which milk is abstracted from the system, as long as fresh chyle was supplied, and sanguification was continued to be performed properly.

A certain portion of chyle must be assimilated to the nature of blood daily, and if there were not adequate excretions going on continually, or an apposition of some of the new matter to decaying parts, then every function of the body, would be soon impeded, and death itself brought on by a *plethora ad molem*.\* On the contrary the body would gradually waste and decay, if there were not, when any one excretion

was

\* “ *Plethora ad molem, quæ et vera dicitur et absoluta, vel apud veteres πολυαμία, ponitque molem sanguinis reapse ita exuberantem, ut partibus continentibus præ nimia distentione incommodet.*”

“ Eam inducit vigor sanitatis sub vitæ genere lautiore, otioso, securo, quo robusta viscera plus generant chyli, sanguinisque laudabilis, quam nutritio ac excretiones necessariæ sibi postulant.”

H. D. Gaub. Instit. Patholog. p. 221. 222.

was particularly encreased, either the suppression of another,\* or a greater than ordinary supply of new chyle.

Thus the *catamenia* of women, who have a copious flow of milk, are most generally obstructed, and in this way a prejudicial depletion is in some measure prevented, as it is during the period of gestation, when the growing foetus deprives the mother of a portion of all the nourishment she receives.

An increased secretion of milk soon after a nurse has taken food, by no means appears to me to be a convincing proof, that the milk, which flows at that time, is nothing more than the chyle newly prepared, from the food just taken. I should hesitate as much in subscribing to such an opinion, as I should to a belief, that the preternatural quantity of urine, which a person voids;  
after

\* “ Mirum inter varias secretionones observatur æquilibrium, ita ut pari fere ratione ac aliæ augmentur aliæ minuantur, quo cautum est, ne corpus adeo facile et subito, ut aliter fieret, exhauriatur.”

Gregorii. Consp. Med. vol. i. p. 374.



after drinking punch or any other diuretic liquor, is constituted by the very particles of the liquor, which he had drunk immediately before. And although some have given way to this opinion,\* yet I think that it is more probable, that a certain *stimulus* is communicated to the kidneys themselves, by means of that consent, which is known to exist between them and the stomach; that perhaps some degree of spasm is formed on the extreme vessels, by which the blood is determined more copiously to the kidneys, exciting their excretory tubes to increased action. †

If we trace the chyle from its source in the intestines to its exit at the nipples of

S

the

\* Darwin's ingenious paper on the retrograde motions of the Absorb. Vessels. p. 40. 41:

† “ Probabile est stimulum quendam ipsis renibus dari, per consensum, quem cum ventriculo habent, et spasmum aliquem forte induci vasis remotioribus, qualis plus sanguinis ad renes dirigat, eorumque actionem intendat.”

Greg: Conspect: Med: vol. i. p. 376.

the breasts, it must surely appear unlikely, that it should mix intimately in the *receptaculum chyli* and thoracic duct, with the returning perfectly animalized lymph; be carried thus compounded into the blood and circulate through the heart and lungs, perhaps repeatedly through the body, without undergoing the smallest change. Nay however acedent the food of the animal be, yet the caseous part of milk always partakes more or less of a putrid nature: which seems to be demonstrative of its having undergone some degree of animalization.

Even nurses, who labouring under fever, abstain from food, often generate milk copiously notwithstanding: and of a kind which is not prejudicial to the infant.\* This surely cannot be chyle unchanged.

But

\* “ Singularem indaginem meretur, quod nutrices febribus detentæ a cibo abstinentes, nihilominus lac in mammis copiosum subinde generant, quod citra noxam infantibus offertur.

Hoffm: oper. om. tom. i. p. 80.

But another argument has been urged to prove that milk is merely unaltered chyle, and at first sight a very specious one, but, upon examination, perhaps it will appear inconclusive.

The serum of blood drawn from the living body sometimes appears like whey; sometimes streaks like cream are observed upon its surface, and at other times it is as white as milk.\*

Four or five pints of a similar kind of liquor have issued from an almost imperceptible orifice in the groin of a boy.†

Four quarts of a liquor, of the same kind, which would not coagulate by heat; but after standing a day or two, was covered with a kind of thin cream, and in a few days more, acquired an acid odour and flavour, was taken from the cavity of the *abdomen* of a girl of eight years old, who

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was

\* Hewson's Enq: into the Propert: of the Blood, p. 141.

† Related by Mr. Patch see Edinb: Med: Essays, &c. vol. v. p. 399.

was tapped for an *ascites*, and who was affected with an universal *anasarca*.\*

Pecquet having found a white fluid mixed with the blood in the right auricle of the heart of a dog, in the year 1651, was led to the discovery of the thoracic duct, by investigating the way, through which that fluid could have passed from the lacteals of the intestines to the heart; for he suspected it to be chyle.†

Dr. Lower related the history of a girl, who after having eaten a good breakfast at seven o'clock in the morning, was bled in the foot at eleven: when the fluid which first flowed from the orifice was half blood half chyle, the latter swimming on the former like a serum as white as milk: and that which came last away seemed to be wholly chyle, without the least appearance of a drop of blood.‡

Many

\* Percival's Essays 2d edit. vol. i. p. 262.

† System of Anatomy, pub: at Edinb: 1784, vol. ii. p. 487.

‡ Phil: Trans: No. 6. p. 100.



Many others have remarked appearances similar to these,\* and Mr. Hewson has given several accurately drawn cases which happened in the practice of some of his friends,† with a view to ascertain the true cause of the phenomenon.

Mr. Hewson acknowledged that he was at first inclined to adopt the common opinion of its being the consequence of bleeding after a meal, before the chyle could be converted into blood. But it occurred to him that those people, of whose cases he had acquired a particular description, had eaten remarkably little food, that some of them vomited

\* Hewson's Enquiry, &c. p. 142.

Halleri: Elem: Phys: tom. ii. lib. v. p. 14. 15. tom. vii. lib. xxv. p. 230, 238, 239. lib. xxviii. p. 24.

Neumann's Chem: Works by Dr. Lewis, p. 569.

† *Mr. French apothecary St. Alban's street. Mr. Robertson apothecary of Earl-street. Mr. Eustace apothecary of Ferymyn-street. Mr. Lambert surgeon of New-Castle-upon-Tyne.*

Hewson's Enquiry, &c. p. 143, and following.

mitted frequently and had bad appetites. That he had observed white serum in the blood of geese, whilst their chyle was transparent, although killed but a few hours after eating.\*

He remarked that no globules appear in serum, in its natural, transparent state; but that many by the assistance of a microscope may be seen in white serum; that these differ from the red particles of the blood not only in being smaller in size, but spherical in shape, agreeing more with the globules of milk. He compared some of them with human milk, in which the globules are of various sizes, some being three or four times as large as others, the smallest just visible with a lens  $\frac{1}{23}$  of an inch focus; but he found those of white serum to be more regular and all about the size of the smallest in milk.†

As the whiteness in every instance is owing to a quantity of small globules like those

\* Hewson's Enquiry, &c. p. 147, 148.

† Ibid: p. 141.

those of milk, which are known to be oily, he concluded that those in white serum are oily likewise.

He inspissated some to dryness, and found it less tenacious in that state, than natural serum, and more inflammable: and that as it dried, its oil oozed out, so as to make the paper greasy.

He kept another portion for some days, which putrified, and when putrid, it jellied like milk when become sour, but was different from milk in becoming very fætid.\*

Now

\* Dr. Lower observed, that, when he heated such serum over a gentle fire, it hardened like the white of an egg, or the serum of blood when heated, but that it was whiter.

Philosoph. Transact. No. 6.

Dr. Alexander Stewart remarked, upon having seen a similar appearance in blood, that if it were chyle, it was a substance very different from milk, which is apt to turn sour and thick by keeping, and never contracts the putrid smell of rotten eggs, as this did after having been kept about six days.

Philosoph. Transact. No. 442.

Now since the globules discovered in white serum are of an oily nature, since those people, in whose blood it was discovered, by Mr. Hewson's friends, had taken very little food, and since the same kind of serum is frequently found in the blood of geese, while their chyle is transparent, so Mr. Hewson rationally concluded, that it is highly improbable, that the whiteness of serum should be owing to unassimilated chyle accumulated in the blood.\*

He was of opinion that it is probable, as the fat laid up in the cellular membrane is occasionally re-absorbed, that this phenomenon is owing to such re-absorption. All the people, whose cases he particularly described, were affected with symptoms of plethora, although they took but little nourish-

\* He does not deny that the chyle may, in the human subject, occasionally colour the serum, for it is frequently observed, that the serum of such people, as are bled a few hours after a meal, is a little turbid like whey."

Hewson's Enquiry, &c. p 150.



rishment, and were relieved by spontaneous hæmorrhagy or by blood-letting.

His method of accounting for a plethoric state of the body, under such circumstances, appears to me to carry with it, not more the character of ingenuity than of truth. He imagined it at least to be probable, to whatever purpose the oil is applied in the body, after it is re-absorbed from the cellular membrane, that, in those particular instances, of which he had procured accurate histories, it was re-absorbed faster than it was applied, and that it was in that way accumulated in the blood vessels.

This opinion he thought received additional weight from the most of those patients being inclined to corpulency, and from two of them labouring under a stoppage of a natural evacuation.\*

If we adopt these facts and this explanation of them, we must entirely reject the idea of whiteness of the serum being a con-

T sequence

\* Hewson's Enquiry, &c. p. 149. 150.

sequence of the presence of unassimilated chyle. If it owed its existence to such a cause, we should, as Mr. Hewson observed, have every reason for expecting to see it oftener, than its occurrence has been remarked.

Hoffman supposed that the milk of those women, who afforded it copiously, after a long abstinence from food, originated from the fat colliquated by heat and mixed with the thin fluid which they drank.\*

If therefore the whiteness of serum be no proof of the existence of recent chyle in the blood, then every deduction from the fact, with respect to an exact similarity of milk and chyle, is totally invalidated.

Neither the instance quoted from Mr. Patch,*a)* nor that related by Dr. Percival*b)* seems to affect this conclusion. No experiments

\* Videtur hoc suam originem habere ex colliquata per calorem pinguedine, quæ, cum potu tenui mixta lacteum succum ingenerat.

Hoff: oper. omn. tom. i. p. 81.

*a)* page 131. *b)* page 132.

ments were made on the fluid remarked by the former; nor was the acescency of that observed by the latter, which in all probability was chyle, nor was its being covered in a day or two with a kind of thin cream sufficient to prove, that milk is merely unassimilated chyle separated by the vessels of the *mammæ*. A day or two is an indefinite term, and even human milk would have thrown up its cream to the surface, in one day; and if not, other proofs were necessary to determine their exact similarity.

But there is yet stronger evidence to prove that either the lactiferous vessels do absolutely secrete something more, than unassimilated chyle from the blood, or that the chyle itself must have undergone some absolute change, prior to its being secreted in the form of milk.

It has been already observed that cows, after having eaten, for a certain time, of madder, yield milk of a red colour.<sup>a)</sup> This

T 2

undoubt-

<sup>a)</sup> page 16.

undoubtedly seems to prove that some of the qualities of the chyle are retained in the milk. But it is as undoubtedly true, that this redness is imparted to the milk, for a whole week after the animal has abstained from eating the colouring substance.\*

In such an instance no one surely can imagine that the milk consists of chyle merely. That it must have derived something from the blood is clear: and the intermediate nature of milk, between animal and vegetable matter, even when the chyle is prepared from vegetable food alone, renders it sufficiently evident, in my opinion, that the chyle, before it is adapted for the formation of milk, undergoes some degree of assimilation.†

Having

\* Qui, *color ruber nempe*, manebat per totam septimanam postquam a rubia tinctorum abstineret.

Young De Lacte, p. 56.

† Neumann's Chem: Works, by Dr. Lewis, p. 569.

Haller: El: Phys: tom. 7. lib. xxviii. p. 25.



Having thus far treated of the natural use, natural properties and origin, I shall in the next place proceed to investigate

THE  
MEDICAL PROPERTIES  
OF  
M I L K.

The dominion, which fashion has ever held, over even some of the most eminent medical men, in certain particulars pertaining to thir practice, has occasioned many ill-grounded and illiberal reflections on the profession at large: nor is there, perhaps, any circumstance more detrimental to mankind.

Medicine has always been esteemed, and in fact is, in a great measure, a conjectural art: and the establishment of practice, upon fixed and certain principles, is a circumstance more to be wished than expected. Popular prejudice is one of the strongest barriers to its acquirement: for, by blinding its votaries, it shuts out every passage to fair and candid enquiry. Thus an article, which  
one

one day is extolled as a specific, or a *catholicon*, is perhaps the next held in universal disregard, neglected and condemned; and from the unmerited applause, which it had met with, the world is often deprived of the real advantages, which might arise from its being properly exhibited.

It is very possible, that many virtues may have been attributed to milk, as to almost every other article of the *materia medica*, which it has by no means a claim to. But upon these grounds it would be extremely unfair to deny it efficacy altogether. Its peculiar nature, intermediate between the animal and vegetable kingdoms, promises as peculiar advantages from its use: for there are certain states of the body, in which animal food would, from its *stimulus* or difficulty of digestion, be extremely prejudicial; while vegetables might be no less hurtful, on account of their acescency, or from their not being sufficiently nutritive.

In

In such instances milk is in general recommended, and, under some form or other, it is particularly beneficial.

Perhaps the chief medical properties of milk depend upon its affording proper and sufficient nourishment to the body, without producing the ill effects of a perfectly animalized or vegetable diet.

It is allowed by physicians, that many of our best remedies are frequently exhibited in doses, by much too inconsiderable to answer the purposes intended by their use. Caution is undoubtedly necessary in prescribing remedies of powerful action; but in my opinion, *nec timide nec temeré* is the rule, by which every medical man of judgment should regulate his conduct.

Milk may be taken to almost any extent by one whose digestive faculties are unimpaired: and some one of its component parts separated from the rest may be administered with advantage; when the milk itself, in its natural, compounded form, would do manifest injury.

Thus

Thus dyspeptic and hypochondriacal patients suffer much inconveniency from feeding on milk: for a disordered stomach is their constant concomitant, if not the source of the greater number of their complaints: but to' such, perhaps, the whey or sugar separated from the cheesy part and cream, would prove most commonly beneficial, from their laxative quality.

Whether there be an acid at all times present in the human stomach, has been long a subject of dispute: and is one, which it is, by no means, my intention to investigate now. That an acidity is the usual consequence of a relaxed or a debilitated stomach is sufficiently demonstrated, by the frequent sour eructations, to which people so affected are obnoxious. Therefore milk, being liable from such a cause, to coagulation in the stomach, is a very improper diet for every one who complains of a weak stomach, and of indigestion;\* unless it be  
combined

\* Hoff: oper. om. tom. i. p. 252. tom. iv. p. 142. 229.



combined with lime-water or with some kind of absorbent medicine.\* It is most probably on this account hurtful to those, who drink immoderately of wine or beer,† or of other fermented liquors.

Milk has been said to be prejudicial likewise to those, who are affected with acute fever, with head-ach, with much thirst, or with flatus; also to such as have bilious dejections, or who have lost a considerable quantity of blood.‡

It is possible that to these cow's milk or any of the thicker milks might be hurtful, and probably on account of their being

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difficult

\* Macbride's *Experim: Essays*, 2d edit. p. 271.

Lieutaud: *Syn: Un: Prax: Med: tom. ii. lib. 1. p. 16.*

Geoffroy *Tract: de Mat: Med: tom. i. p. 76.*

† Hoff: *oper. om. tom. ii. p. 180.*

Sydenham: *Tract: de Podagra.*

‡ “*Lac exhiberec apitè dolentibus, malum. Malum item & febricitantibus, & quibus præcordia sublata murmurant, & siticulosis. Malum quoque & quibus biliosæ sunt dejectiones, quique febre acuta laborant, & quibus copiosa sanguinis dejectio facta est.*”

Hippoc: *aphor. sect. v. aphor. 64.*

difficult of digestion under such states of the body; although the whey separately, nor butter-milk might produce any ill effects: but on the contrary, either of them would, most likely, be of considerable service to patients in such situations.

As an article of diet cow's milk is most generally preferred, both on account of its plenty and cheapness, and perhaps this kind is frequently detrimental to many, to whom either ass's or mare's milk would be perfectly agreeable.

It is the cheese or coagulable part of milk, which is the most incommodious: and I have pointed out before, that the milk of the mare and of the ass contains a considerably less proportion of this part, than cow's milk.<sup>a)</sup> But as one, so perhaps every kind is hurtful to many, from some peculiar idiosyncrasy,\* which occasions the  
stomach

<sup>a)</sup> page 44.

\* Lieutaud: Synop: Univ: Prax: Med: tom. ii. lib. iii.

p. 557.

James's Med: Dictionary. Article Lac.

Med: Museum, vol. iii. p. 368.

stomach to reject it; or if retained under such circumstances, it is liable to induce very disagreeable effects in the system. Experience will point out to these the impropriety of taking it, and the physician will avoid its use, when he is made acquainted with the peculiarity of his patient's constitution. The milk of the ass, from its greater tenuity, is esteemed preferable to cow's milk, for most medical purposes; it contains a greater proportion of the saccharine part, than the milk of any other animal, and perhaps, on this account, is the most nutritive.\*

Milk, as an article of the *materia medica*, is arranged under the head demul-

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cents,

\* "We have facts to prove, that sugar alone is nutritious, and we shall afterwards endeavour to prove, that all fruits, we use, are nutritious only from their sugar."

Cullen's Mat: Med: Dublin edit. p. 39, 40, 78.

"I have been told of two pigs, one fed with the same quantity of milk, the other with sweet cow-whey: the latter became the fattest, whitest, and sweetest."

James's Med: Dictionary. Article 'Lac.

Med: Museum, vol. iii. p. 369.

cents,\* or emollients.† Considered as a demulcent it has often been prescribed, with the view of obtunding the acrimony of drastic purgatives or of corrosive poisons: and not unfrequently where the intention has been to correct a vitiated state of the blood.

The good effects arising from its use, as an emollient likewise, in many instances of inflammatory affections, are recorded upon the testimony of some of the first medical authors.

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Whenever the design has been to sheathe the stomach and intestines from the *stimulus* of acrid medicines or poisonous substances, cow's milk has been generally prescribed. It is the most readily procured, and of all the kinds of milk, which contain a considerable proportion of the oily and mucilaginous part, that of the cow may be taken in the greatest quantities, without becoming incom-

\* Liecutaud: Synop. Univ. Prax. Med: tom. ii. lib. i. p. 15.

† Hoff: oper. om. tom. i. p. 430.



commodious to the patient ; and perhaps on this account is to be preferred, although goat's and ewe's milk, being of a thicker consistence, might otherwise be supposed to be more adapted for the purpose.

Children from having their stomachs well fortified with milk, are observed to bear acrid substances comparatively better than people advanced in years.\*

Perhaps butter taken with this intention would be extremely more advantageous than milk itself. Thus, in order to recommend a *nostrum* against poisons, certain mountebanks have been said to boast, that they could swallow corrosive sublimate, arsenick, and the like acrid poisons with impunity, having a remedy to prevent the bad consequences, which commonly result from the use of such active preparations. They would indeed swallow either in public ; but were discovered to be ever in the habit of filling their stomachs with butter,  
before

\* Hoff: oper. om. tom. i. p. 215.

before they ventured on the use of the poisonous substances; and in this manner they rejected them immediately without danger.\*

A remarkable instance is related by Hoffman of the good effects of milk, in the cure of ten children, who had taken a very large quantity of arsenick in their food.† And another of a nobleman, who had incautiously taken by six times a larger dose of certain drastic pills than had been prescribed for him; in whom every bad symptom was taken off, by his immediately having recourse to a large quantity of cow's milk.‡

Hoffman likewise relates the case of a man, of rather a delicate constitution, for whom a student of medicine had incautiously ordered some pills of a drastic nature, which almost immediately produced vomiting and violent purging. These  
symp-

\* Hoff: oper. om. tom. i. p. 201.

† Ibid:

‡ Ibid: p. 215.

symptoms continued for many days, and reduced him extremely low, so as to deprive him of appetite and sleep. When Hoffman visited him he found that his patient had, for some weeks, been subject to colliquative night-sweats, that his pulse was quick and weak, and that he was wasting away with slow fever. He ordered him to drink a certain quantity of whey prepared from goat's milk, at different periods of the day, with twelve drops of his anodyne liquor, and to drink plentifully of water-gruel: by the use of these articles his appetite returned, and in twelve days he recovered his health and strength perfectly.

He mentions another case of a gentleman, who from passion became affected with nausea and straining to vomit: with a view to relieve these symptoms, he took some kind of emetic medicine: this operated so violently as to reduce his strength to a very low ebb, and to bring on a burning heat at the stomach, watchfulness and loathing of food.

food. Hoffman, fearing an inflammation of the stomach, ordered him nothing but whey with an emulsion of the four cold seeds, to be drunk at proper intervals in doses of a few ounces. From the use of these his patient was greatly relieved, his heat and burning sensation at the stomach abated, his pulse became strong, and his sleep returned with every hope of health.

He relates another case of a female child, of a delicate constitution, about three years old, who had been ordered by her physician a purging medicine of calomel and jalap, with a view to defend her from an attack of the small-pox, which was at that time raging epidemically. It had operated only twice or thrice, but so affected her, as to destroy her appetite, to bring on restless nights, watchfulness, great thirst, intense heat and quick pulse. Hoffman recommended the use of whey, by which she was restored to sound health.\*

Other

\* Hoffm: de saluberr Seri Lactis Virtut: oper. om. tom. vi. p. 16.



Other instances of the same kind have been noticed, and the deleterious effects of hemlock are said to have been counteracted by the use of milk alone.\*

It has been supposed, and perhaps with just reason, that the alexipharmick properties of milk depend upon its oily and mucilaginous nature, through which, by involving the *spicula* of the noxious substances, it obtunds their acrimony, and prevents their deleterious action upon the nicely sensible coats of the stomach and intestines.

This property of milk was well known to Hippocrates, and to others, who recommended its use after the taking of certain drastic purgatives.† And it has been remarked that the violent action of the greater

X spurge

\* Nov: act. physico-med: Academ: Cæsar. Leopoldino-Carolin: curiosor: exhibent: ephemerid: tom. x.

† Si venter nigro elleboro purgatus fuerit, supernè vel infernè, aut etiam scammonii succo, post purgationem serum ac lac bubulum aut caprinum vel etiam asinum commodissime exhibetur.

Hippoc: de intern: affection: 46

Med: Museum, vol. iii. p. 399.

spurge is so weakened, by its being reduced into an emulsion with goat's milk, as to be rendered a safe and useful remedy in dropfy.\*

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It is neither an unfrequent nor an injudicious practice, among many, in curing a confirmed *lues venerea*, to order a solution of corrosive sublimate to be taken in a draught of milk: its operation is in this manner rendered less prejudicial to the system, without impairing its anti-venereal properties.

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The good effects of milk, in remedying an acrimonious state of the fluids, have been confirmed by the advantages which have arisen from its use in scorbutic affections, and in the cure of venereal and cancerous ulcerations of various parts of the body.†

The

\* Hoffm: oper. om. tom. i. p. 215:

† Hoffm: oper. om. tom. i. p. 423. 431. tom. vi. p. 7. de mirab: lact: affin: in medend:

Med: Museum, vol. iii. p. 404.

Dr. James's Med. Dictionary. Article Lac.

Bened: *Sylvaticus*: *Monro*, &c.

Young de Lacte, p. 55.

The remedies, which seem most calculated to answer the purpose of changing the nature of vitiated humours, are such, as, with a stronger tendency to correct putrefaction than to putrify, possess much matter proper for nourishment. And perhaps no one article possesses such properties, in a more eminent degree, than milk: and of the different kinds of milk none perhaps promises such advantages, as that of the ass.

By being a substance of easy digestion, it is most readily converted into a proper chyle, and most likely to be copiously conveyed by the lacteals and thoracic duct into the mass of blood. In its circulation through the body it is well fitted to give that fullness to the vessels, which is requisite for the promotion of the excretions, by which the noxious parts are thrown off from the common mass of fluids: while, through the medium of the same circulation, a proper apposition of nutritious particles is made, wherever attrition or decay has rendered

them necessary. Thus by a constant supply of proper chyle, and by the promotion of the excretions an absolute change is gradually made in the nature of the blood; and by the apposition of new matter to decayed and decaying parts, a due tone and vigour is as gradually restored to the system, and with proper care supported.

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Milk, perhaps with not less justice, has been esteemed a good preservative against putrid fevers, as well as useful in their cure. Its mode of operation here is, in all probability, similar to that above described; for it seems to me to be rational to conclude, that whatever will cure a disease, by a given operation, will likewise, by a similar operation, tend greatly to prevent its attack.

When prescribed with this view, if it be given in the form of butter-milk it promises the most salutary effects, for it is in that state an agreeable sub-acid liquor, deprived of its most indigestible part, the mucilage or cheese.

This



This liquor makes up a considerable share of the common beverage of the poor of certain populous places, as Manchester, &c. to the use of which a great share of their good health and freedom from putrid disorders is attributed.\*

The whey of milk alone has also been taken with great advantage during the course of malignant fevers.†

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Perhaps, in the cure of all inflammatory diseases without exception, either butter-milk or whey would prove a most excellent remedy: for if milk, as taken from the animal, be at all stimulating and thence hurtful, yet, under these forms, it is deprived of the part, in which that quality most particularly exists.

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Milk,

\* White, On Pregnant and Lying-in Women, third edit. p. 156.

† Hoff: Hist: Feb: petech: 1683, in Principatu Mindensi grassant: vide oper. om. tom. ii, p. 88. tom. iii, p. 39.

Milk, and that of the ass in particular, has, in every age of physic from Hippocrates to this day, been esteemed, as it were, the sheet anchor in preserving every one affected, from the most alarming symptoms of *phthisis pulmonalis*.

Such is the unhappy state of phthifical patients, that, although wasted and for ever gradually wasting, through mere inanition, not being able to bear the *stimulus* of common food, they cannot reap the advantages of a tolerable appetite, which they commonly possess through the whole course of their illness: "for in the hectic, the appetite is less impaired, than in any other kind of fever."\*

As milk is a kind of food, which affords ample matter for nutrition without greatly stimulating the system, so it must be the best adapted for those, whose complaints are such as render the *stimulus* of other diet, either dangerous or hurtful. And as  
that

\* Cullen's First Lines, 4th edit. vol. 2. p. 366.

that kind of food, whatever it be, which can, without injury to a part, afford nourishment to the whole of the body sinking for want of it, must be the best remedy, that can be administered to alleviate the ill effects of inanition, so milk may be properly ranked among the most effectual palliatives in *phthisis pulmonalis*: a disease ever attended with a general *macies*, and which, from the organ affected, when once confirmed will perhaps ever be incurable.

The laxative quality of asses milk, butter-milk and whey, renders them often particularly advantageous, in the early stages of *phthisis*; of which costiveness is frequently rather a troublesome concomitant. Should they not be sufficiently laxative of themselves, the addition of a small quantity of *cassia*-pulp, or of *manna*, as occasion may require, will be fully adequate to the preserving of the bowels regularly free: as the action of such  
purgative

purgative sweets is remarkably increased by those liquors.\*

The *tinctura Tolutana* is a medicine very often prescribed in hectic cases, and, whatever efficacy it may have, it cannot be given in a more grateful form to the patient, than mixed with milk, it has the property of thickening the milk in some little measure, and perhaps contributes to its nutritive quality.

If the fever should not be violent, and either the use of bark, or of calybeat medicines, or of mineral waters be indicated, in order to give tone to the system, there is no vehicle so commodious, nor so elegant as milk for administering either. Hoffman was so conscious of the peculiar excellency of mineral waters taken in this manner combined with milk,† that he

wrote

\* Lewis's Mat: Med: by Aikin, p. 371.

† Although milk is coagulated by the addition of most of the middle salts, the basis of which is either an  
earth



wrote a treatise expressly on the subject: \* and thought that it was worth recording that he was the first, who introduced the practice into Germany. †

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Indeed there are but few disorders, in which milk or whey has not been recommended, either separately or compounded with different medicines. ‡ I confess, how-

Y

ever

earth or a metallic body, as a solution of alum, fixed sal armoniac, sugar of lead, and green and blue vitriol, yet neither the chalybeat nor purging mineral waters, nor the bitter salt extracted from the purging waters, produce this effect. Most of the neutral salts, but nitre especially, have the property of rendering the milk more diluted than it naturally is, a) and hence the chalybeat or the purging mineral waters, or neutral salts, may be frequently added to milk with much advantage.

a) Neumann's Chem: Works, by Dr. Lewis, p. 574.

\* De connubio aquarum mineralium cum lacte, &c.

Hoff: oper. omi. tom. v. p. 223. et sequent.

† Ibid: tom. iii. p. 290. tom. v. p. 224. 226.

‡ Hoff: de connubio aquar: min: cum lacte, &c.

Hoff: De mirabili lactis asini in medendo usu. tom. vi. p. 1. et sequent.

ever much I would be the advocate, that I am greatly inclined to think, that many effects have been attributed to the action of milk when compounded, which have been produced by the operation of some other ingredient of the composition.

As all the natural excretions are promoted by its use either given as milk, as buttermilk, or whey, without stimulent effects, it is most certainly calculated for giving relief in all diseases, which are accompanied with an inflammatory *diathesis*, and hence it has been recommended, with success, in the cure of *hæmoptoe* and of other disorders of the breast;\* of *hæmorrhagia*;† of acute pains and spasm from a stone impacted in the kidneys, &c.‡ and as advantageous to those, who are recovering from acute diseases.

\* Hoff: oper: om: tom. ii. p. 206. 210. tom. iii. p. 291.

† Ibid: tom. ii. p. 220.

‡ Ibid: tom. ii. p. 301.

eases.\* Milk, the whey of milk and butter-milk, being likewise articles which afford nourishment to the body, without either rousing the circulation, or exciting a degree of fever during their process of digestion, are extremely convenient and proper vehicles for administering different remedies, in those diseases of an inflammatory nature, of which a loss of appetite is a concomitant symptom: for as the patient lothes even that food which is requisite for his sustenance, it is answering a double purpose to administer the medicines, proper for the cure of the disease, through a medium, which is best calculated to prevent the ill consequences of inanition.

Dysentery is often a disease of this nature, and I have seen this mode of practice successful in the cure of dysentery; when the fever was of the inflammatory kind: nor  
would

\* Young De Lacte, p. 68.

James's Med: Dictionary. Article Lac.

Med: Museum, vol. iii. p. 378.

would the practice seem less rational, although the fever were of a putrid type,<sup>a)</sup> which it frequently is.

Baglivi asserted that he had very often cured dysenteric affections, with the whey of milk alone, and he remarked that many kept this remedy against dysentery as a very great secret.\*

Hoffman mentions, when in 1726 a dysenteric affection, of which many died, was very prevalent in some parts of Germany, that butter-milk and whey were used, through the whole course of the disease, and that they were found to be the best remedies.†

The use of milk and of whey in the cure of dysentery is of very antient date, it was well understood by Hippocrates, who particularly recommended it.‡

Nor

<sup>a)</sup> Page 156, 157.

\* Prax: Med: lib. 1.

† Hoff: oper: om: tom. iii. p. 162.

‡ Lib. vii. Epidemicor: sect. v. § 2.



Nor is it less approved in modern practice. Dr. Cullen observes, when treating of the diet proper to be used during this disease, that “milk in its entire state is of a doubtful quality in many cases, but that some portion of the cream is often allowable, and that whey is always proper.\*

Sir George Baker, in his very learned and elegant treatise on the dysentery which prevailed in London in 1762, remarks, that the different preparations of milk were used as the most proper articles of diet, and that the whey of milk was sometimes found to be more eminently serviceable than any composition of medicines.†

A very

\* First Lines, 4th edit. vol. iii. p. 119.

† Sorbitionibus utendum erat ptisanæ, alicæ, vel oryzæ, omnibusque quotquot ex lacte comparari solent; eo quod lac mitissimum alimenti genus præstet, quodque ventrem emmolliat simul ac liquet. Nec minimum laudis merebatur serum illud lactis vulgare (cui sane multum antiqui medici tribuerunt) neutiquam certe contemnendum, quod parabile sit, et vilis pretii; cum, misturis medicamentorum quibuscunque palam aliquando præ-

A very obstinate case of a dysenteric kind fell some years ago under my own observation, which was cured after all the usual remedies had failed, by the use of the medicated milk, which Dr. Mead recommends in the cure of flow and hectic fevers.\* This appears to me to be a very elegant mode of exhibiting milk, whenever astringents are admissible, and

præripiat. Etenim corruptæ miscuisse novam et sinceram materiam proderat. Proderat (ut loquar cum Sydenhamo) hoc lenissimo liquore, morbum tanquam diluvio submergere.

Lib: de Catarrho et de Dysenteria Londinensi epidem: utrisq: An. 1762. p. 63. 64. 65.

\* “ Flores rosarum rubrarum siccatarum, balaustia, cortex malorum granatorum, cinnamomum, singulorum drachma una, coquantur in lactis vaccini libra una. Cum ebullire incipit, frigida aqua affunditur parva portione, ut restinguatur et subsidat; finitur iterum ebullire, et eodem modo restinguitur; idque toties faciendum est, donec libra una absumpta, lactis simul et aquæ quod restat, libræ unius mensuram adæquet. Tum colendus est liquor, quem totum, commisto saccharo, paritis, uti commodum erit, haustibus, ægrotus ebibet quotidie.

Mead: Monit: et Præcept: Med. p. 49. 50.

and it is a *formula*, which I have frequently imitated with success in the cure of *diarrhea*.

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Milk has been prescribed in certain affections of the stomach, where the event has confirmed the advantages of its use.

Dr. Young, the late Professor of Midwifery, in the University of Edinburgh, related the case of a lady, who, for eighteen months was afflicted with a most severe pain about the region of the stomach, with loathing of food, and frequent vomiting of whatever she swallowed. She had taken various emetic, stomachic, laxative and opiate medicines without relief, when she applied to him for his opinion. All he prescribed to her was the country, and the use of mare's milk, which she immediately had recourse to, and in three months, without the assistance of any other remedy, she returned home free from all complaint.

Dr.

Dr. Young observed that he had seen many instances of people, labouring under diseases of the stomach, being restored to perfect health by the use of milk, and of food prepared with milk, without any other assistance, after they had tried many other medicines without relief.\*

Assé's milk is particularly recommended by a most ingenious and one of the best writers on the pathology of pregnancy as an important article of use during that state:† nor has the use of milk been esteemed of small importance to those, who have long laboured under hysterical affections,‡

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#### Injections

\* Young De Lacte, p. 73. 74.

† White on Pregn: and Lying-in Wom: 3d. edit. p. 67. 71.

‡ “Etenim mulieres aliquot (quod prima statim fronte mirabitur quis) cum affectibus hystericis diu conflictatæ etiam iis, qui omnes medicorum conatus spreverant eluserantque, tandem, lacte solo aliquandiu vescentes convalescere.”

Sydenham: oper: Med: edition: Genevæ, editæ: 1723, p: 425.



Injectiōns of milk thrown high into the intestines have been attended with such happy effects in certain cases, that it seems not a little surprizing, that the custom of prescribing them is not more general than it is.

*Enemata* of milk, or of whey either alone or compounded, stand recommended upon high authority, as proper for overcoming the constipation, which is sometimes attendant on ardent fevers ;\* as adapted to quiet the inordinate action of the intestines in the latter stages of hectic cases :† in *cholera morbus* and in bilious *diarrhœa* :‡ and to alleviate the flatulency and *tormina* to which infants are so frequently obnoxious.§

But the advantage of nourishment, to be derived from this mode of administering milk, is often of the highest importance.

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There

\* Hoff. oper. om: tom. ii. p. 117.

† Ibid: p. 179.

‡ Ibid: tom. iii. p. 168.

§ Ibid: p. 480.

Boerhaav: Aphor. 1347.

There are many cases, in which a loathing of food, or some affection of the mouth *œsophagus* or stomach excludes every possibility, of giving a sufficient quantity of nourishment, in the common way, to sustain life. I am indeed suspicious that the quantity of a patient's *ingesta* is not at all times properly attended to: and that he is frequently imagined to be sinking under the force of his disease, when the most alarming symptoms arise from a want of nourishment: which, with but a little trouble, it is possible to give him, without offending his disordered stomach.

In 1783 I had the honour of being an assistant to Dr. Gregory in the clinical wards of the Infirmary at Edinburgh, which were appropriated for the reception of those patients, on whose cases, he, as Clinical Professor was to read lectures. When a woman applied for relief, whose case exhibited a very remarkable instance of the

*Tem-*

*Pemphigus major* of Nosologists,\* a disease of very rare occurrence. At one period during its progress, it became necessary from the singularity of its symptoms to administer nourishment to the patient *per anum*.

When I first saw her, several large vesicles, formed by the cuticle detached and elevated, as big as a crown piece appeared upon her left hand and arm, one on her left side, and another between her shoulders, turgid with a faintly yellow, serous fluid. After a few days one of the same kind came out on her tongue, and others afterwards on her neck and face, and all over the roof of her mouth *fauces* and *pharynx*, at length extending down the *œsophagus*, and most

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probably

\* Typhus contagiosa:

Primo, secundo, aut tertio morbi die; in variis partibus vesiculæ, avellanæ magnitudine, per plures dies manentes, tandem ichorem tenuem effundentes.

Gener: Morbor: Culleni tom: ii. 3tæ edit: p. 148.

Sauvage: Nosol: Method: tom: i. p. 430.

probably into the stomach, and through the whole tract of the intestines: as she referred the sensation of pain progressively to various parts of the region of the stomach, and *abdomen*. Until the cuticle burst or was cut and the confined fluid discharged, the pain was extremely severe; and, as she expressed it, very similar to that occasioned by any part being scalded with hot water; so that, when her mouth *æsofagus* and stomach were affected, she could neither swallow, nor even bear milk in her mouth. In this state of symptoms Dr. Gregory ordered *enemata* of cow's milk: which were repeated from time to time with peculiar advantage, until she was enabled to take medicines and food by the mouth again.\*

I

\* I might have been induced to have given a more accurate and particular account of this curious and very extraordinary case, were I not in hopes, that there is some reason to expect, that the public will be favoured with it, from Dr. Gregory himself. I know that it was once his intention to give his sentiments upon it,  
to



I confess my own regret, at having in some instances neglected to order a patient to be supported in this way, even in common fevers, when a loss of appetite was the only objection to the taking of food by the mouth.

If indeed a patient could possibly be prevailed upon to drink from two to five or six pints of butter-milk or whey daily, according to circumstances, there is no doubt but that to take it in this way is far preferable to administering it in any other. And I am persuaded that, in a great number of instances, this practice might be attended with good effects, whether the fever were of an inflammatory or putrid tendency.

It is the practice among many of the Spanish and Italian physicians, to prescribe  
what

to the Philosophical Society of Edinburgh. The woman had been his patient some time before, with the same disease; of which he cured her then, as well as when I had the fortunate opportunity of attending her, with many others variously afflicted, under him.

what they call the *Diæta aquea* in the cure of fever. This consists in a total abstinence from every kind of food and liquid, except plain water: of which they direct their patient to drink six or eight pints daily for several days together, in divided portions, generally cold, but sometimes warm.

“ By thus supplying a quantity of watery fluids to the system, they bring on a relaxation of the spasmodic stricture on the vessels of the surface,” which is a very frequent symptom of fever, “ and consequently promote the excretion of the skin, which is often one of the chief objects to be attended to in the cure of fever.”\*

Butter

\* Cullen's First Lines, 4th edit. vol. i. p. 151.

As I have here quoted Dr. Cullen, perhaps some may be disposed to accuse me of presumption, for adding the spasmodic stricture on the surface, as only a frequent symptom of fever, but I give it as my own opinion. Dr. Cullen indeed contends, that it is not merely a frequent symptom, but that it is present in every instance, and that

Butter milk and whey are equally calculated to promote this excretion by a similar operation, and we have every reason  
to

that it is in fact the proximate cause of fever. (*First Lines*, 4th edit. vol. i. p. 37, 46.) It will be at all times with the greatest diffidence and caution, that I shall venture to doubt the truth of any doctrine, that I have been taught by a man, whose accuracy of observation, and whose judgment I have so much reason to hold in high estimation, as I have that of Dr. Cullen. But every man, who has the welfare of science at heart, justly assumes to himself the right of suspending his faith of every doctrine, which seems to be supported more by the subtilties of ingenious reasoning, than by the established and invariable laws of nature. And he lays it down as a fixed maxim *nullius in verba magistri jurare*. Such has ever been the principle upon which I have endeavoured to regulate my own conduct, nor would I abandon it until some one shall have taught me a better. Upon this principle I have frequently ventured to observe, that, if I dare trust to the accuracy of my own senses, I cannot do otherwise than hesitate in believing the validity of this fundamental proposition of Dr. Cullen's doctrine of fever; although I would not, trusting to my own senses alone and opposing my own accuracy of observation to his, venture to assert it false. I  
have

to expect far greater advantages from using them, than from the use of plain water, as they are greatly more nutritious, diuretic, and

have frequently seen instances of fever, which appeared to me to have been accompanied through their whole course with a moist skin, or a free perspiration: and he who can believe, if the fact were so, that such a state is compatible with a state of spasmodic stricture on the vessels of the surface, at any period of the disease, so as to be reckoned its proximate cause, must, in my humble opinion, be a man of monstrous and incongruous faith.

I find among my notes a memorandum of an instance of fever which very remarkably tends to invalidate the opinion: a woman of the name of *Susan Scrimgeour*, ætat. 22, was admitted into the Clinical ward of the Infirmary at Edinburgh, Nov. 4, 1783. She had at that time the common symptoms of fever, head-ach, much pain about the lumbar region and lower extremities, frequent nausea and vomiting, loss of appetite, considerable thirst, a white but moist tongue, and her pulse was soft and beat 100 in a minute. These symptoms commenced about five days before, and were preceded by rigor the common harbinger of fever; but at the time at which I remarked the above symptoms *she had a spontaneous sweat universal over her whole body except her legs*, which, as she said, were particularly cold.



and laxative, and I cannot but acknowledge myself to be of an opinion, that more good might be very often done by the use of

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these

cold. Her bowels were likewise lax, and her *catamenia* had missed one period. *Foveantur crura statim: habeat jalap. diaph. ℥ss. omni hora ad quartam vicem, postea tertia quaque hora.*—5<sup>th</sup> pulse 108 and soft, heat moderate, *skin gently moist and had pretty constant sweat until the morning*, head-ach worse, nausea relieved, some diarrhea, no appetite, thirst, tongue white but moist, *catamenia supervenerunt hodie, omittatur julap: diaph: habeat julap: salin: ad ℥i. altera quaque hora, et haustum anodynum cum laudani liquidi g<sup>tis</sup> xxv. hora somni, et decoctum avenaceum ad libitum.*—6<sup>th</sup> pulse 110, heat considerable, *copious general sweat for about 18 hours*, no diarrhea, head-ach relieved, tongue, thirst, and anorexia as yesterday, *catamenia heri cessarunt, hodie denuo redierunt: repetatur julap: salin: et haust: anod:* She was worse in the evening; hora 6<sup>ta</sup> p. m. capiat vini ipecac: ℥ss. statim, et iterum post semihoram nisi prius evomuerit, et habeat infus: flor: chamæm: ad promovendum vomitum.—7<sup>th</sup> vomited well with first ℥ss. of the vin: ipecac: was purged once by it, slept very well, no appearance of delirium, *copious sweat at present*, pulse 116 very soft and even feeble, tongue as foul as ever, but less thirst and some little appetite, head-ach

these liquids, whether taken by the mouth, or injected *per anum*, than by forcing on an enfeebled stomach a *farrago* of medicines.

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ach relieved but great weight of the head still, eyes slightly inflamed and tender, hearing as acute as usual if not more so. Capiat 6<sup>ies</sup> indies pulv: cort: p. ʒij. habeat aquam cardiac: anglie gin punch, cum succo limonum ad gratum acorem ad lbij. indies, repetantur julap: salin: et haust anod: h. s.—8<sup>th</sup> pulse 108, tongue moist and much cleaner, appetite mends, head easier, more sleep but slight delirium, *skin cooler but moist*, repetantur medicamenta.—9<sup>th</sup> pulse 100 still soft but stronger than for these two last days, heat very moderate, *copious gentle sweat still continues*, some appetite to-day, pretty constant dosing and some delirium this morning, tongue rather cleaner, eyes still a little tender, repetatur haust: anod.—10<sup>th</sup> *skin cool and soft, no more sweat*, tongue clean and moist, pulse 84, appetite pretty good, but little sleep in the night, and some delirium in the morning, alvus adstricta per biduum, repetantur medicamenta, et vesperi injiciatur enema ex aquæ tepidæ lbis.—11<sup>th</sup> pulse *skin and tongue natural* appetite still weak, sleep not sound nor refreshing, glyster operated, continue.—12<sup>th</sup> pulse almost natural, little appetite, almost constant dosing, continue.—13<sup>th</sup> 14<sup>th</sup> and 15<sup>th</sup> convalescent.—16<sup>th</sup> symptoms of fever recurred,

A proper use of milk has ever been considered, as one of the best means of preventing and of curing the gout.

As there are two opposite states of this disease, the inflammatory and atonic, so either living too luxuriously or too abstemiously is alike disposed to bring on a paroxysm. There-

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fore

recurred, and continued more or less violently until 20<sup>th</sup> when she became again convalescent: she took bark, wine, &c. during this relapse: *her skin was ever moist, and sometimes a copious spontaneous sweat pervaded the whole body.* She went out Dec. 3<sup>rd</sup>.

I have been particular in remarking the circumstances of this case, because many of the most observing students of that year considered it as a fact, which tended strongly not only to invalidate the theory of spasm as a proximate cause of fever, but to prove likewise that it is by no means a constant symptom. The above reports were accurately taken down verbatim as Dr. Gregory gave them at the patients bed-side, nor did the instance escape him. In his lectures, on the fever-patients, he gave this case among others of a similar nature, which had occurred to him in practice, as facts, from which deductions might be drawn, that must extremely weaken the force of the most ingenious arguments in favour of that doctrine.

fore the intermediate nature of milk renders it very fit for affording much nourishment without the acescency of vegetable, and without the *stimulus* of animal diet, and it must be consequently well adapted for the use of gouty patients in either state of the disease.

The existence of all diseases, which descend from parent to progeny in hereditary succession, seems to depend upon the action of some cause, which cannot be eradicated, by any of the known means of applying the powers of medicines. And hence such diseases have been called *opprobria medicorum*.

Perhaps their cause is so intimately connected with the original structure, so dependent on a mal-conformation of the body, as to be fixed greatly beyond the reach of human assistance. There are certain symptoms however of such diseases, which we have it frequently in our power to alleviate, nay, we may sometimes avert for a time the most imminent danger.

In respect to the gout, perhaps both the alleviation and security depend, in most instances



instances, more upon the patients own conduct than on the skill of the physician. “ It is animal food which especially disposes to the plethoric, and inflammatory state, and that food is to be therefore especially avoided; but on the other hand it is vegetable aliment of the lowest quality, that is in danger of weakening the system too much, by not affording sufficient nourishment; and more particularly of weakening the tone of the stomach by its acescency. It is therefore a diet of a middle nature, that is to be chosen, and milk is precisely of this kind, as containing both animal and vegetable matter.”\*

Many instances have been known, of gouty people keeping free from an attack for years, from making milk their chief article of food, a very extraordinary case of this kind is remarked by a Dr. Samuel Pye, which is of a gouty person, who lived free from an attack of gout for thirteen years, having abstained  
from

\* Cullen's First Lines, 4th edit. vol. ii. p. 97, 98.

from every kind of food, except cow's milk, even from bread during the whole period.\*

It may not be improper to notice, that the ancients ordered milk, in far greater quantities, than the moderns in every curative intention, that there is no reason why its quantity should be restricted, if it prove not inconvenient nor hurtful to the patient; and that every kind is always most salutary when taken as recently drawn from the animal as possible.

The nature of the disease itself together with the effects of the remedy will best point out, to any one capable of judging, how long it's use ought to be persisted in.

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Before I entirely quit the subject, I cannot avoid mentioning the cures of gout which are said to have been performed by a long continued use of the sugar of milk. I confess they appear to me to border on the marvellous, but whatever doubts may be  
enter-

\* Lond: Med: Observ: and Enquir: vol. i. p. 41.

entertained respecting the accuracy or truth of their histories, yet if, by omitting them, it should so happen that I omitted to notice a useful remedy against so grievous a complaint, even although of far less efficacy than it is said to have been, I should most certainly have reason to accuse myself of an unwarrantable neglect.

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PROPERTIES AND EFFECTS  
OF  
THE SUGAR OF  
M I L K.

The methods of preparing the sugar of milk have been already described. *a)* The discovery of it has been attributed by some authors, but perhaps undeservedly to Ludovicus Testi, formerly an eminent physician of Venice.\* I have observed, in a former part of this dissertation, that it is not deliquescent in the common atmosphere, but that

*a)* page 42.

\* English Translat: of Dr. J. S. Duvernois' Dissert: on the Sugar of Milk, p. 5.

that it is entirely soluble in water, from which it may be readily obtained again, in a crystallized form: that it is likewise completely soluble in all the mineral acids without violent action, imparting a dark brown colour to the vitriolic acid, from which it is not precipitated by the addition of alkalis.*b)* Alkalies and acids are indeed said to act equally upon it. It acquires a yellowish or blackish colour from exposure to air.\* and it produces evidently laxative and diuretic effects when taken as a medicine.†

Some

*b)* page 56.

\* Duvernois' Dissert: p. 5.

† Ibid: p. 20.

Two kinds of acids may be obtained from the sugar of milk, of which Bergman gives the following account:

“ Saccharum lactis a Bartoleto primum memoratur anno 1619,*a)* sed nemo ante D. Scheele ejusdem analysin perfecit.*b)* Centenarius hujus salis, acidi sacchari præbet  $15\frac{1}{2}$  libras, et alius acidi, hætenus in solo lactis saccharo inventi, hæc considerandi, circiter  $23\frac{1}{2}$ .

*a)* Encyclopædia Hermetico-dogmatica.

*b)* Acta Ac: Stockh: 1780.

Hoc



Some very extraordinary cures of gouty affections have been attributed to the continued use of this sugar, which, I confess, I think it safer to quote, than to vouch for. If they be indeed faithful histories of real cases, the sugar of milk must be esteemed an invaluable remedy. But however the fact may be, as its operation is unattended by any danger or even violent effects, it is certainly most adviseable for the afflicted to put its reputed powers to the test of experiment.

B b

Aloy.

Hoc acidum instar pulveris albi concretum obtinetur, aquam difficulter subit, nam ferventis partes 60 non nisi 1 suscipiunt. Solutio heliotropium rufat.

Alkalinis nuptum salibus connubia format longe solubiliora, sed nihilo minus aquæ fervidæ pondus requirunt, pluries solvendum superans. Terris adunatum hoc acidum aqua vix solvi potest.

Qua attractiones inter alkalia consuetus ordo locum habet. Terra ponderosa, calcarea et magnifica alkali-bus prævalent. Inter illas principatus ægre determinari potest, quum aquam vix subeant."

Opuscula Physica et Chemica, vol. iii. p. 375, 376.

Aloysius a Fabra, Doctor of Physic and Philosophy at Farrara, is said to have assured Ludovicus Testi, that many gouty persons had used the sugar of milk, with great success, particularly one John Denzis, thirty-six years old, a painter of Bologna in Italy, but who resided at Ferrara. He was afflicted for ten years; at first in his foot, and afterwards in his hands; and at length his joints were full of knobs. For four years he was not free, for a month together, from an erysipelatous swelling, attended with acute pain and burning heat. His disease continuing, the knobs and chalk stones round the joints of his hands and feet became worse, and his feet were at length so contracted and inflexible, that he was deprived of all possible motion and kept his bed continually. He had likewise an exacerbation of fever every night, with excessive thirst, quick and hard pulse, excruciating and universal pains. In this state Dr. a Fabra advised bleeding; the blood  
drawn

drawn “ after it had stood awhile was a jelly, quite white and clotted at top ; and kept or preserved the substance of only one-fourth part of a blackish, rather than a reddish fluid of no consistence.” The Doctor, after other things had been tried, recommended to him the sugar of milk. He began to take it on the 10th of June, observing a proper and regular diet, and taking likewise weekly some gentle laxative medicine. By these means he found such benefit and ease, that his feet and hands were rendered pliable ; he could walk about briskly, and follow his trade as he had done before he was ill. But what was more wonderful, about the middle of July following, there began to run, from a chalk stone and knob in the left hand, which was larger than the rest, a chalky matter, liquid or dissolved, as if it were the whitest pus, with something like corrupted blood, in which were little crumbs, very small and few in number, like unto the hardness of

lime; this discharge continued for twenty-four days. The rest of the chalk stones and knobs went away as well from the right as from the left hand. The *sinus* left by this corrupted sort of matter, acquired such a smoothness and softness, that being squeezed, the hardness being gone, they would bear to be handled without pain.

The limner afterwards continued to pass his days chearfully, followed his employment, and wrote a letter to his Doctor, telling him that he continued the use of his sugar of milk.

Dr. a Fabra concluded that this case afforded grounds to hope, that it is possible for the gout, accompanied with chalk stones and knobs, to be cured.\*

The same physician is likewise said to have communicated the histories of certain other cures of the same nature to Ludovicus Testi.

One

\* Append: to the Transl: of Duvernois' Dissertat: p. 24, 25, 26.



One in the instance of the Marquis Cornelio Bentivolio, a noble Venetian, who was scarcely ever free, for a month at a time, from an attack of an hereditary gout, until he began to take the sugar of milk.

Another, in the instance of a gentleman, whose name was Cæsar Gualander. He was accustomed to have three or four severe fits of the gout in a month, he was of a fallow complexion, which was greatly taken off, and his disease cured by the use of the sugar of milk.

The third cure he mentions from the use of this sugar, is of Jacob of Italia, a Jew, who had been tormented for ten years; his complexion was likewise a good deal improved.\*

Cajetanus De Angelis Mevanatis, Doctor of Philosophy and Physic, and Professor in the city of Todi, is also reported to have written to Ludovicus Testi, an account of  
the

\* Appendix before quoted, p. 27.

the cure of the Rev. Father F. Bernard de Montefalchio, in a monastery of the Holy Mount of Todi. He had been confined for ten years to his bed, by the gout, but after having taken the sugar of milk for three months, he received so much benefit, that he recovered the use of his limbs, and all the chalk stones, with which his hands were laden, and one on the right elbow as big as an egg, were dissolved in the same manner as Dr. a Fabra related of the painter.

Vincent Clericus, a most eminent physician of Parma, and reader of practical physic in that University, gives an account of a certain *religiosus*, who was tortured for seven years, with the most acute pains of the gout, although they sometimes abated a little according to the changes of weather. The disposition of his body was sickly, being filled with obstructions almost every where. His *abdomen* was hard, with a tension of the spleen and liver; and at length he was  
affected

affected with jaundice to such a degree, that he scarcely had the look of a human creature, through the deformity of his face and skin. After having used all the methods his physicians could think of, he was advised by Vincent Clericus to take the sugar of milk, and upon using it only four months, having taken a laxative medicine before he began it, the native colour of his face and skin returned, the obstructions mentioned vanished, and what was more extraordinary, the gouty pains entirely ceased, and he was restored to the perfect health of his whole body.\*

The general dose is said to be from  $\mathfrak{z}\text{ss}$  to  $\mathfrak{z}\text{ij}$  taken twice a day.†

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In the course of my reading since the greater number of these sheets have been  
sub-

\* Append: before quoted, p. 28, 29.

† Translat: of Duvernois' Dissert: p. 20.

submitted to the press, I have fallen upon some passages in different authors, which I should not have passed unnoticed, had I remembered those of them, which I had read before, or seen those earlier which I never saw till now; and therefore I thought it better to make mention of the chief of them in a postscript, than to neglect to notice them altogether.

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POST-



## P O S T S C R I P T.

I N the 34th and following pages I have offered some arguments, with a view to prove that the natural use of milk is strictly limited to the infant progeny of those animals, which possess proper organs for secreting it. But I find that a gentleman to whom the medical world is very much indebted, Mr. C. White of Manchester, entertains and has published, in respect to cow's milk, an opposite opinion. I never had seen the little tract, in which Mr. White has given his sentiments upon this subject, until within a few days since; when his son, my friend Mr. T. White, knowing that I was publishing this dissertation, did me the favour of presenting me with it.

The paper which I allude to, Mr. White professes to have printed merely for distribution among his friends, and has entitled it "*A Natural History of the Cow, as far*

*as it relates to the giving milk, particularly for the use of man."* And the general inference, which he draws is, that there is some reason to conclude that the cow was, by the omniscient Author of Nature, intended for this purpose.

In proof of this opinion Mr. White observes, that the cow differs in some parts of its organization from most other animals, having a larger and more capacious udder, and longer and thicker teats, than the largest animal we know. That the size and form of the teats appear, at the first sight, as if they were made on purpose for the hand to draw off the milk, that the thickness permits the lactiferous tubes to be of a larger diameter, and that the length of them makes the syphon so much longer, and the extraction of the milk of course so much more easy. He notices likewise, that the cow has four teats, whilst all other animals of the same kind have but two. This Mr. White considers as a striking peculiarity, the number in all other animals bearing  
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some proportion to the number of young ones, they bring forth at a time, as in the bitch, the cat, the sow, &c. But that the cow does not bring forth, at a birth, more young ones, than those animals who have but two teats. The cow, says Mr. White, yields the milk as freely to the hand, and will continue to give her milk, for as long a time, without any calf coming near her, as if it were permitted to suck her constantly, whilst most animals, at least those that do not ruminate in the same manner, refuse it, except their own young, or some adopted animal be allowed to partake. The instance he quotes in proof of this fact, is of the ass. Lastly, Mr. White remarks, that human milk cannot long be preserved in the breasts, without the child be permitted to suck. That it otherwise soon acquires a bad, saltish taste, and, in a short time, leaves them entirely; and that this will happen, if the child alone suck, if it be not permitted to suck four or five times a day. He adds, that the most dexterous and skilful

women, who draw breasts, have not been able to keep the milk without the assistance of the child, although they have swallowed the milk, and repeated the suction four or five times a day. And he infers that goats, sheep, and rein-deer give milk freely to the hand, without the kid, the lamb, and the fawn having access to them, because they are ruminating animals of the same kind with the cow, that is, possessing strong digestive organs, by which they extract every thing from their food, which is capable of being converted into chyle, and that therefore they yield a greater quantity of milk.

I would, by no means, because, in a former part of this dissertation, I have taken up an opinion different from that, which Mr. White holds, support that opinion in defiance of conviction; but I confess that Mr. White's arguments do not appear to me to carry conviction along with them.

There is no fact in physiology better established, than that all the secretions  
and



and excretions of animal bodies are augmented by the application of *stimuli* to the organs secreting them, and we have proof in the examples of saliva and milk, that friction is a *stimulus* very powerfully productive of this effect.

As every secreted, as well as excreted fluid of the body is separated from the general mass of circulating blood ; so a greater than ordinary flow of either implies a greater than ordinary derivation of blood to the organ secreting it, and one effect of such a derivation cannot but be an encrease of the bulk of the organ itself. Now whatever be the first cause of such an influx of blood, to the *mammæ* during the time of pregnancy ; whether sympathy between them and the *uterus* or whatever else ; yet we know, as it is asserted by Mr. White himself, that the afflux will not long exist after parturition without the assistance of considerable friction. The friction itself, together with the consequent continued secretion becomes a cause of the encreased diameter of the

the lactiferous tubes, and likewise of the length of them, so as to render the syphon longer, and the extraction of the milk so much more easy. It must frequently have occurred to Mr. White to see that the nipple prior to suction, has been so sunk in the breast, as with difficulty, if at all possible, to be withdrawn: so it occurs to common observation with respect to cows, that the teats are extremely small prior to suction or some other species of friction, compared to what they are, after the frequent repetition of either. The udder of the cow, prior to gestation or friction to her teats, is not in the least comparatively larger, than the breast of a woman prior to pregnancy.

If then the increased capacity of the udder be at first an effect of gestation, and its continuance in that state, together with the enlarged diameter and length of the lactiferous tubes, an effect of frequently repeated friction: or if frequently repeated friction be the cause of the increased bulk of the whole

whole, in either case, being merely the effects of accidental or of mechanical causes, they cannot with the least degree of propriety, in my opinion, be assumed as an evidence of design, in the omniscient Author of Nature, to appropriate the produce of the cow's udder to the use of mankind.

Even if the capacity of the cow's udder, and the diameter and length of the lactiferous tubes were in fact formed, originally, comparatively larger than those of any other animal: might we not suppose them to have been formed so for the conveniency of the animal's own progeny? Were the udder less, and the teats shorter, these would be extremely inconvenient for the calf's sucking, while that would contain milk in too small a quantity for its support: nay, we find that it is not the most capacious udder that affords milk most adapted either to the luxurious appetites, or to the conveniencies of mankind. The Guernsey and Alderney cows are considerably less in stature than any others of the whole race, their udders  
and

and quantity of milk proportionably small, but yet the milk, which they yield, is held in the highest estimation, and affords more butter, than the milk of any other kind of cow.\*

Why the cow, the goat, the sheep, or rein-deer, should more quietly submit its udder to be unloaded by the hand, than the ass or the mare, is a problem of no very difficult solution if we consider the effects of habit; neither why the secretion of milk is continued in those animals without the assistance of their young, while the mare and ass under similar circumstances become dry, when we take a view of the comparative degree and frequency of friction made use of to the teats of each.

The fact is, that the cow, the goat, the ewe, and rein-deer, necessarily for the support of their own young, afford milk more copiously than other animals; and that they are, for this reason, selected by mankind,  
de-

\* Young De Laële, p. 11.



deprived of their young, and rendered subservient to domestic purposes : and that this is done by slow degrees, for all alike refuse until long habit familiarizes them to the hand, to yield up their burthens, in that way, more quietly than the unaccustomed ass or mare.

When the ass or mare is milked, by the hand, it is chiefly for medicinal purposes, and sparingly ; not with sufficient frequency nor duration to continue the secretion, without the assistance of their young ; yet we have many instances in the streets of London of the passive obedience of the milch ass. But the cow's udder is so drained, morning and evening, that there is no milk left for the support of her progeny, and she yields to the hard necessity of separation with signs of inquietude and with sad reluctance.

The impossibility of preserving human milk for any length of time in the breasts, without the infant sucking, is sufficiently demonstrative of friction only being requi-

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sitate to produce the effect of secretion. We cannot have the smallest reason to expect that even the most skilful and dexterous at drawing breasts, should continue the secretion as well as an infant. A woman's swallowing the milk could surely have no effect in enabling her to draw it off better. The teeth of an adult render her mouth very uncalculated for the office of sucking, for the nipple could by no means endure the necessary pressure, if made with the teeth, but that which the infant gives, with its soft gums, so far from being painful, imparts a pleasing sensation.

It is impossible that any particular effect should ensue from the infant's sucking, which might not be produced by an adult performing the same office, except what may depend upon the manner of doing it; and this is a faculty, which the young of lactiferous animals, and those only, instinctively enjoy; and hence puppies have the power of continuing the secretion of milk in the  
breasts

breasts of a woman, when those, who make it their business to draw breasts, have not.

Any argument founded on the number of teats most certainly can be but little conclusive ; for if we can suppose that one nipple was considered by the Author of Nature to be less than adequate for nourishing one infant, so we may with equal propriety conclude that he considered two teats less than necessary to afford a sufficient quantity of milk, for the support of one calf ; and the peculiarity will cease to be striking.

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In p. 52 I observed that the first sensible spontaneous change, which milk undergoes is that of becoming acid. I indeed made no experiments, with a view to obtain this acid of milk in a separate state ; but, by looking over the 3d vol: of *Bergman's opuscula physica, et chemica*, I see that a process is described for this purpose.

“ Ut

“ Ut acidum lactis, spontanea aceſcentia coagulati, obtineatur” ſays Bergman, “ ſerum colligatur et vaporando diminuatur donec  $\frac{1}{3}$  tantum remaneat. Hoc reſiduum calce ſaturandum eſt, ut calx phosphorata ſecernatur, dein acido ſacchari præcipitetur calcareum ſolutum, tandemque ope ſpiritus vini reſtificatiſſimi ipſum acidum lactis adquiretur calce phosphorata, ſaccharo lactis, alkali vegetabili et mucilagiñoſo, quæ lacti inhærent, liberatum adquiretur.*a)* )

Hoc acidum inter acetum et acidum formicarum quaſi medium eſſe videtur, attractionis tamen virtute acetum ſuperat. Ad-dito ſpiritu vini et per menſem digerendo in acetum re vera mutatur.

Cum alkalibus ſales efficit deliqueſcentes, itidemque cum terris, quarum tamen magnesia præter expectationem reliquis magis ſtabile procreat connubium. Præter zincum vix ullum metallum cum hoc acido in cryſtallos abit, ne quidem plumbum, quod dulcem præbet ſolutionem et plumbi vitriolati quidquam deponit.

Qua

*a)* D. Scheele in *Annis*, Stockh: 1780.



Qua alkalia et terras idem valet attractionum ordo ac pro aceto.\*

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It might have been remarked in p. 81. that the evolution of volatile alkali, is not, in every instance, a proof of the existence of either animal or of putrid vegetable matter, "since many fresh vegetables and tartar afford a considerable quantity of it."†

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In p. 144 I have said, that it is still a question of doubt, whether or not there be an acid at all times present in the human stomach. It is worthy of remark, that Mr. Hunter, in a note at the end of his paper *On the Digestion of the Stomach after Death*,‡ asserts,

\* Opusc. vol. iii. p. 377. 378.

† Dr. Black's Exp: on Magn: Alb: &c. p. 31.

‡ Philos: Transact: vol. lxii. p. 447.

asserts, that " In all animals, whether carnivorous or not, upon which he made observations or experiments to discover whether or not there was an acid in the stomach (and he tried it in a great variety) he constantly found that there was an acid, but not a strong one, in the juices contained in that viscus in a natural state."

T H E   E N D.

*The Author requests the favour of the reader to correct the following typographical errors, and any others that he himself may have passed over, in the hurry of correcting for the press, when a good deal occupied in other avocations :*

Page	9. line	2. of the note for aliquid read aliquid
18.	10. after d)	insert ‡
20.		first reference for lib. xxiv. read lib. xxviii.
21.	4.	for certian read certain
63.		last reference for Macquier's read Macquer's
74.	4.	for acridity read acrimony
		last reference for Macquier's read Macquet's
91.	2.	for congeling read congealing
92.	5.	for p'lan read pan
109.		Exp. xxvii. for effectd read effected
112.	1. of note 11	for perforably read prefera! ly
137.	6.	for character read characters
197.	20.	for afflux read efflux







